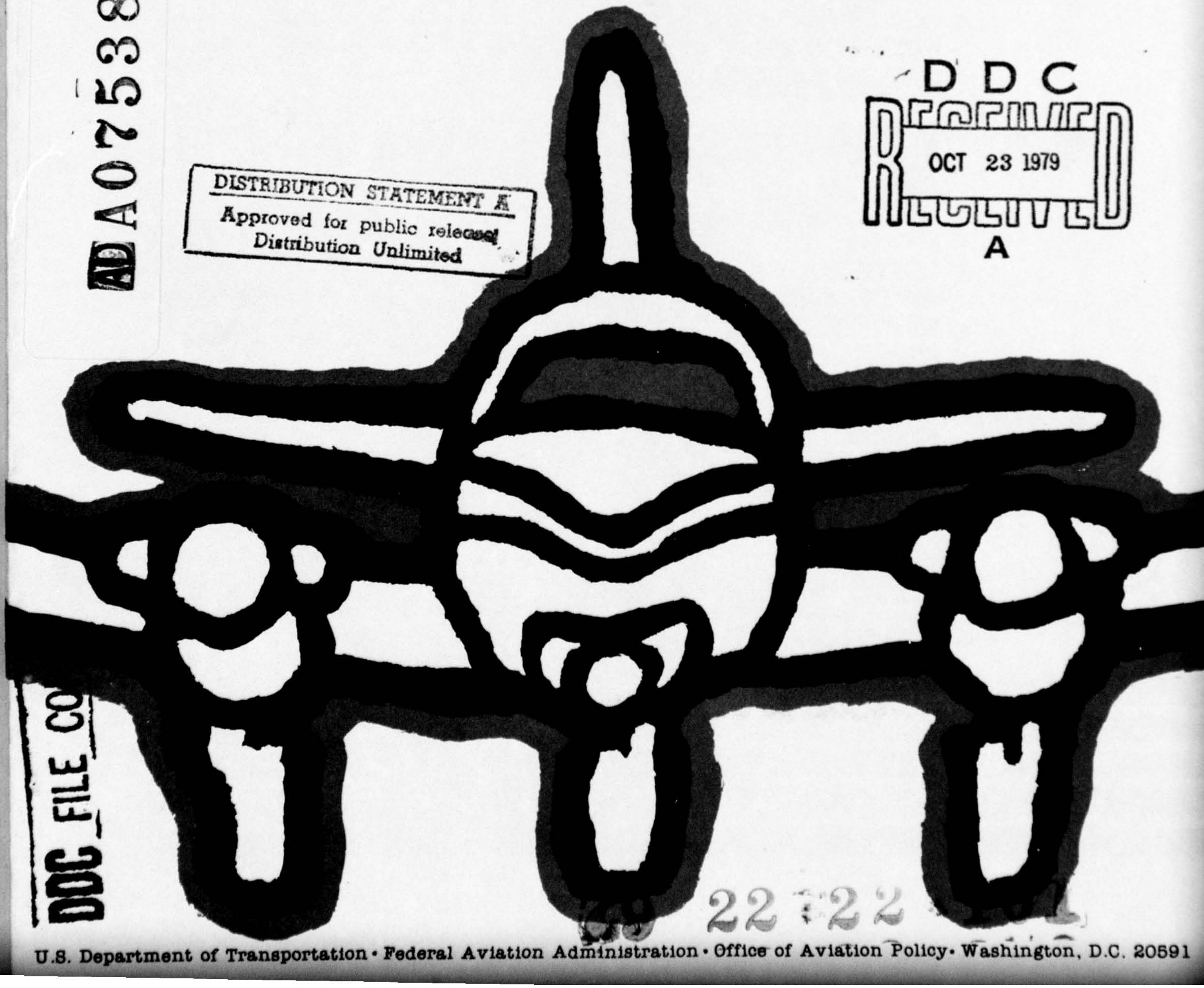
September 1979

FAA Aviation Forecasts

Fiscal Years 1980-1991



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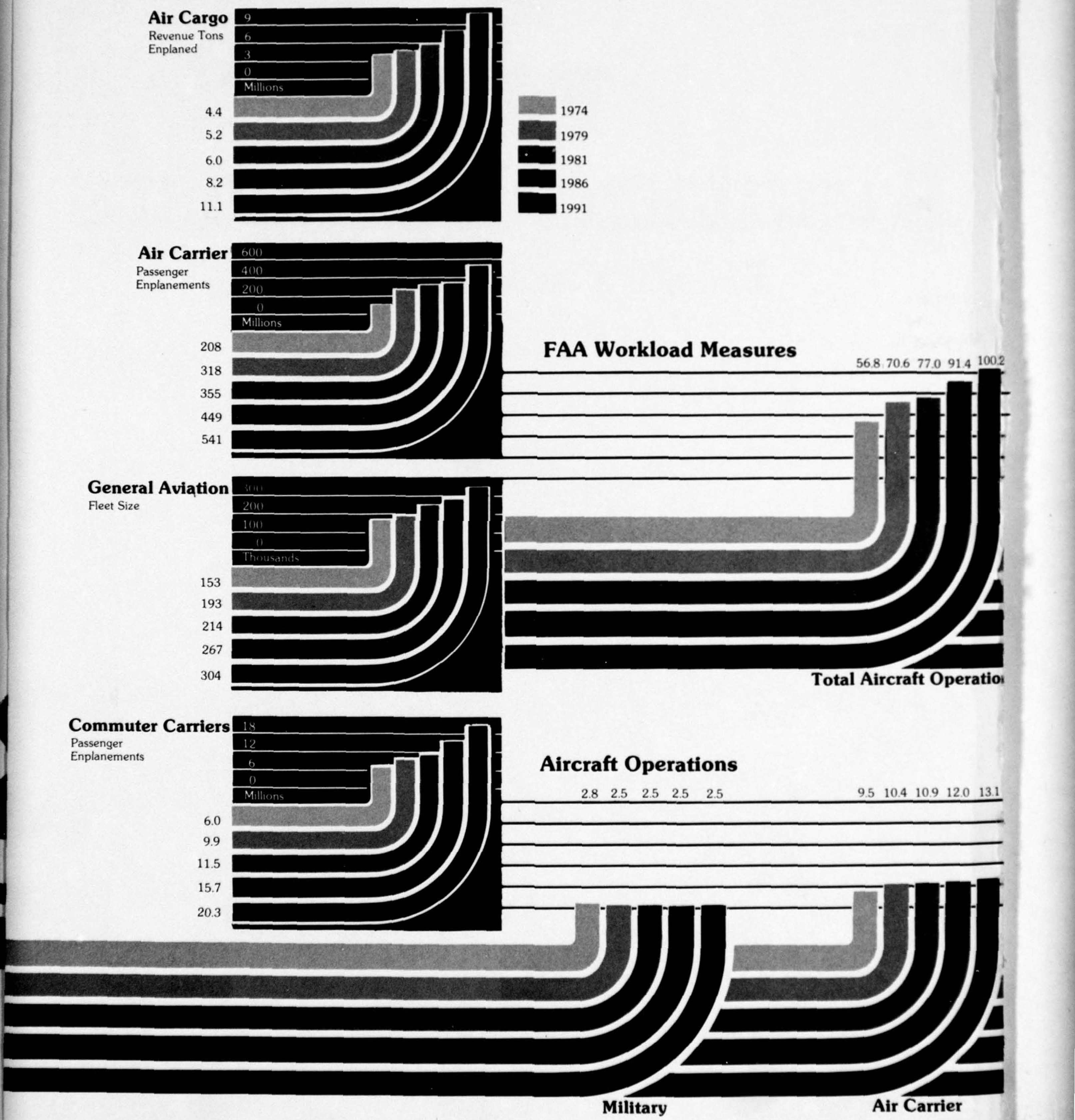

Air Cargo
Revenue Tons Enplaned
9
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8.2
11.1
1974
1979
1981
1986
1991
Air Carrier
Passenger Enplanements
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200
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Millions
208
318
355
449
541
FAA Workload Measures
56.8 70.6 77.0 91.4 100.2
General Aviation
Fleet Size
300
200
100
0
Thousands
153
193
214
267
304
Total Aircraft Operatio
Commuter Carriers
Passenger Enplanements
18
12
6
0
Millions
6.0
9.9
11.5
15.7
20.3
Aircraft Operations
2.8 2.5 2.5 2.5 2.5
9.5 10.4 10.9 12.0 13.1
Military
Air Carrier

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The official Federal Aviation Administration (FAA) forecasts of domestic aviation activity for the years 1980 to 1991 are presented in this volume. It contains forecasts of aviation activity at FAA towered airports and Air Route Traffic Control Centers, as well as services provided by flight service stations. Aviation activity forecasts for the four major users of the National Airspace System--the trunk and local air carriers, the air taxi and commuter air carriers, general aviation, and the military--also are presented.

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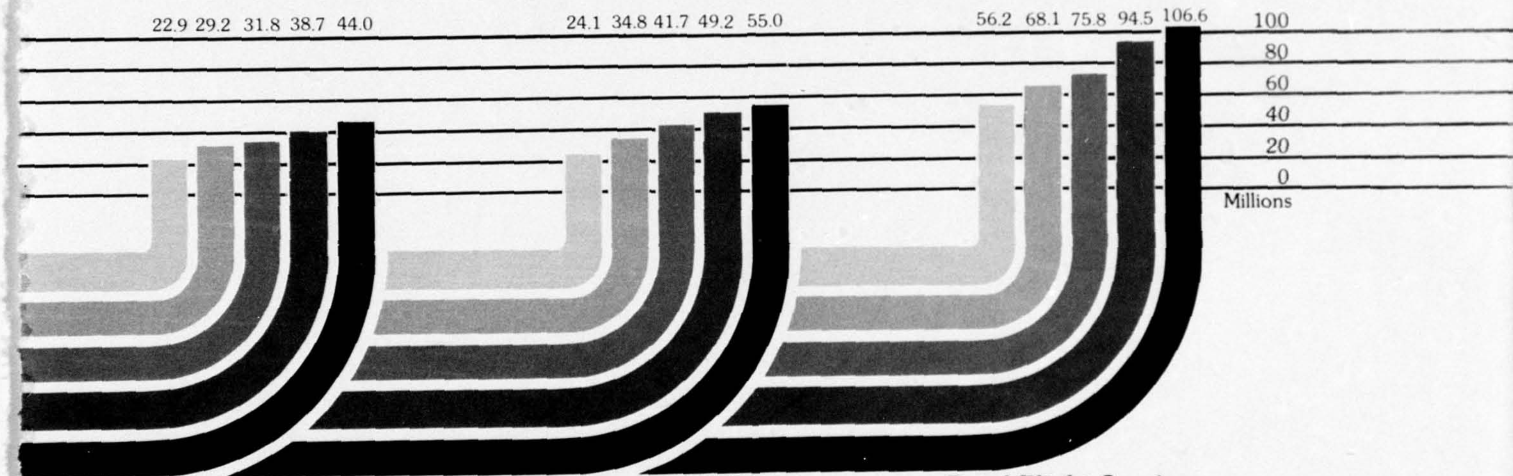
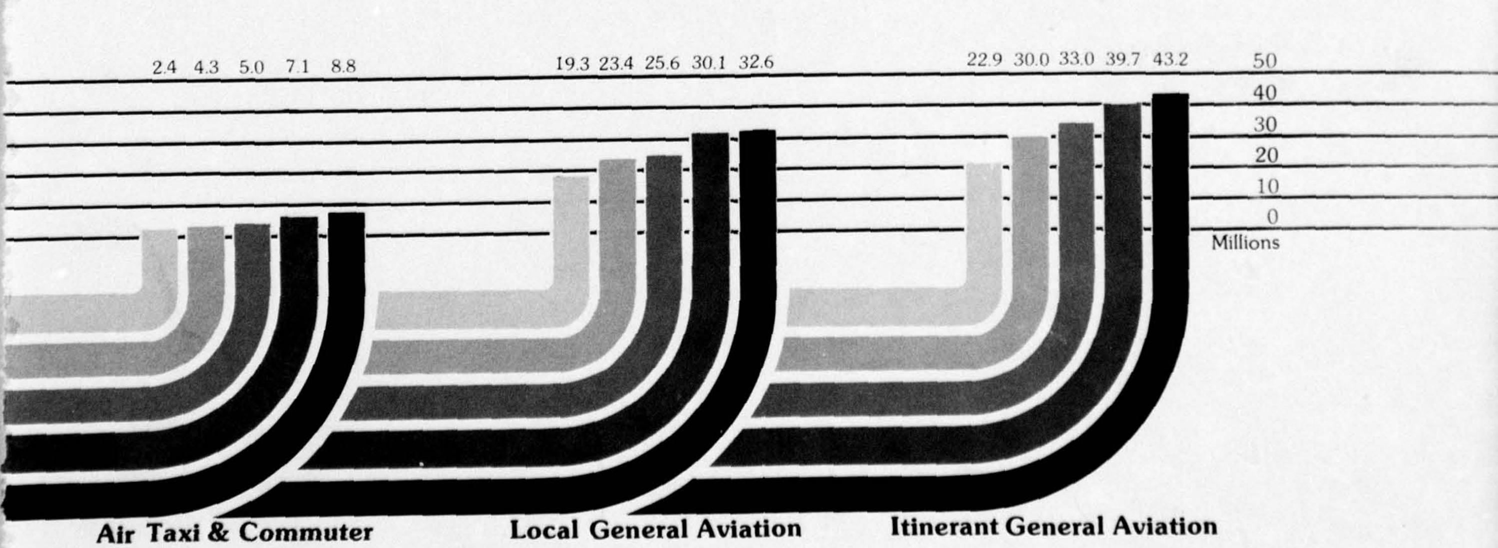
Overview

FAA Aviation Forecasts FY 1980-1991



IFR Aircraft Handled **Instrument Operations** **Total Flight Services**



Air Taxi & Commuter **Local General Aviation** **Itinerant General Aviation**

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Preface

The official Federal Aviation Administration (FAA) forecasts of domestic aviation activity for the years 1980 to 1991 are presented in this volume. It contains forecasts of aviation activity at FAA towered airports and Air Route Traffic Control Centers, as well as services provided by flight service stations. Aviation activity forecasts for the four major users of the National Airspace System—the trunk and local air carriers, the air taxi and commuter air carriers, general aviation and the military—also are presented.

This annual report has become an important document in the planning process of many jurisdictions and agencies beyond the FAA. Consequently, the first two chapters are included as a means of providing a context against which the baseline forecast may be assessed. We encourage readers and forecast users to employ this additional information as a foundation for analysis of their own needs and projections of aviation activity.

Acknowledgements

This document was prepared by the Policy Development Division of the FAA Office of Aviation Policy. Mr. Gene Mercer, Chief of the Aviation Forecast Branch, led the forecast development and production process. The following individuals were responsible for individual subject areas:

General Aviation — Thomas Henry and Pamela Kruzic
Air Carrier — Bernard Hannan and Janice Hartwill
Air Cargo — James Hines
Commuter Air Carriers — Pamela Kruzic
Flight Services and Instrument Operations — Thomas Henry
FAA Workload Measures — Janice Hartwill
Aviation Scenarios — Kenneth Harris and Robert Weiss

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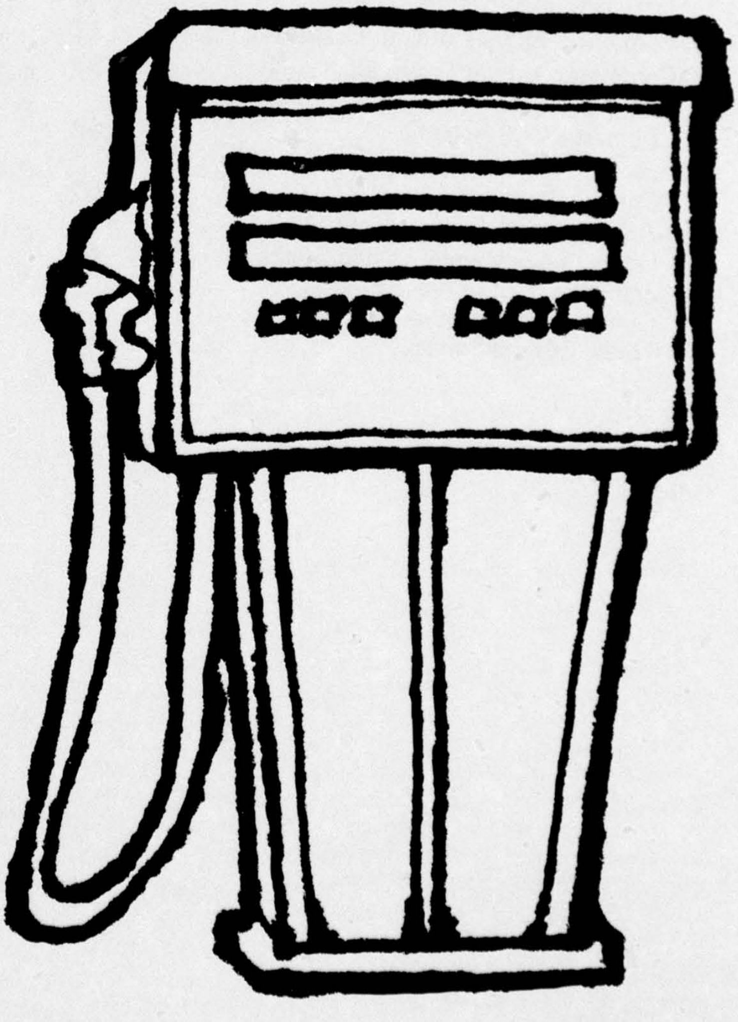
Summary of 1979 FAA Aviation Forecasts

The official 1979 Federal Aviation Administration (FAA) forecasts of domestic and the United States portion of international aviation for fiscal years (FY) 1980 through 1991 are summarized below. In general, the experience of the past year and current expectations of growth for the next 12 years support a more moderate pattern of growth in aviation than has been obtained over the past ten years.

Table 1 presents estimates of aviation activity during 1979, projections of activity for 1991, and average annual growth for the 12 year forecast period. Table 2 presents average annual growth, total growth for the periods FY 1979 through 1981 (two year forecast) and FY 1979 through 1991 (12 year forecast). Table 2 also shows historical data for 1979 and the five year period 1974 through 1979. Thus, historical growth can be compared with projected growth over the nearer term (1979-1981) and the long term (1979-1991).

Air Carrier and Commuter Aviation Activity

Special fares, expanded route structures and improved general economic conditions combined during the period 1974 to 1979 to produce higher than average annual growth rates in enplanements among the air carriers and commuter airlines. The 1978 to 1979 change was the



most dramatic. It reflected the immediate effects of the Airline Deregulation Act of 1978, as well as some definitional changes in the count of air carrier enplanements.

The air carrier growth rates projected for the period 1979 to 1991 are more modest. These lowered growth rates reflect a consensus on the expectation of more moderate economic growth during the forecast period and the judgement that the growth rates experienced as a result of deregulation can not be sustained.

Much of the recent growth in passenger traffic has been accomplished without a corresponding increase in air carrier operations. Higher load factors were generally sufficient to accommodate the additional enplanements.

The trend toward greater average seating capacity, in part due to new aircraft, will continue during the forecast period. The consequence of increased aircraft seating capacity is reflected in the expectation of a 78.3 percent increase in air carrier revenue passenger miles and only a 26.0 percent increase in air carrier operations by 1991.

Commuter operations are anticipated to more than double over the next 12 years. This expectation is based on the increased opportunities available to these carriers. For the first time, the aircraft loan guarantee program has become available to them. They are also eligible for subsidy payments if the communities they serve require the subsidy. Furthermore, new commuter markets will be created as the air carriers exit from marginal markets.

Air cargo is expected to enjoy higher growth rates during the forecast period than it has in the historical 1974-1979 period. The anticipated growth in revenue tons enplaned and, particularly, revenue ton miles is attributed to a continuing acceleration in growth of time-sensitive shipments and cost factors favorable to air cargo in relation to ground freight transportation modes. Freight and express will account for this increase with air mail holding fairly steady throughout the period.

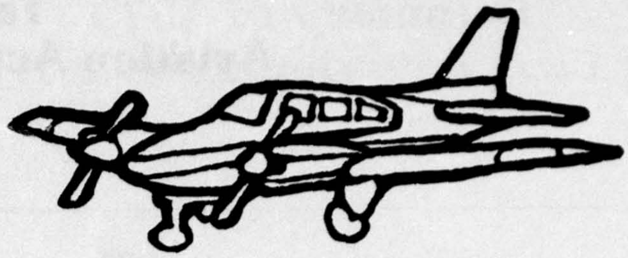
General Aviation Activity

General aviation will maintain only slightly lower growth rates than it has experienced over the past five years. Higher aircraft utilization rates are forecast because general aviation is increasingly being used by business flyers as an effective means of meeting their transportation needs.

FAA Workload Measures

Aircraft Operations. Total aircraft operations at airports with FAA towers will increase at a 4.4 percent average annual rate between 1979 and 1981. Over twelve years the average annual growth rate is 3.0 percent. The largest increase in growth rate among aircraft operations is expected to be among air taxi and commuter carriers. While an effect of deregulation among the air carriers is largely a redistribution of their operations, the anticipated increase in commuter operations will raise total aircraft operations at airports with FAA towers.

Instrument Operations. Significantly greater use of avionics among commuter airlines and the general aviation fleet will contribute most of the 58.0 percent increase in instrument operations at airports with FAA towers over the next 12 years. Instrument operations



conducted by commuters are expected to more than double during the forecast period.

IFR Aircraft Handled. More use of sophisticated avionics by the air taxi/commuter and the general aviation fleets will also increase the workload at the FAA Air Route Traffic Control Centers. The total number of IFR aircraft handled at these Centers will increase 50.7 percent over the next 12 years. Growth in air carrier aircraft handled will be only 25.5 percent, while air taxi/commuter and general aviation will more than double.

Flight Service. Flight services provided by FAA Flight Services Stations will grow by 56.5 percent over the forecast period. As in the case of instrument operations and IFR aircraft handled, a large part of this increase is attributable to increasing use of more sophisticated equipment by general aviation pilots. Particularly, the business flyer is expected to make greater use of these services in support of safe flying under more diverse conditions.

Table 1
Aviation Activity Forecasts

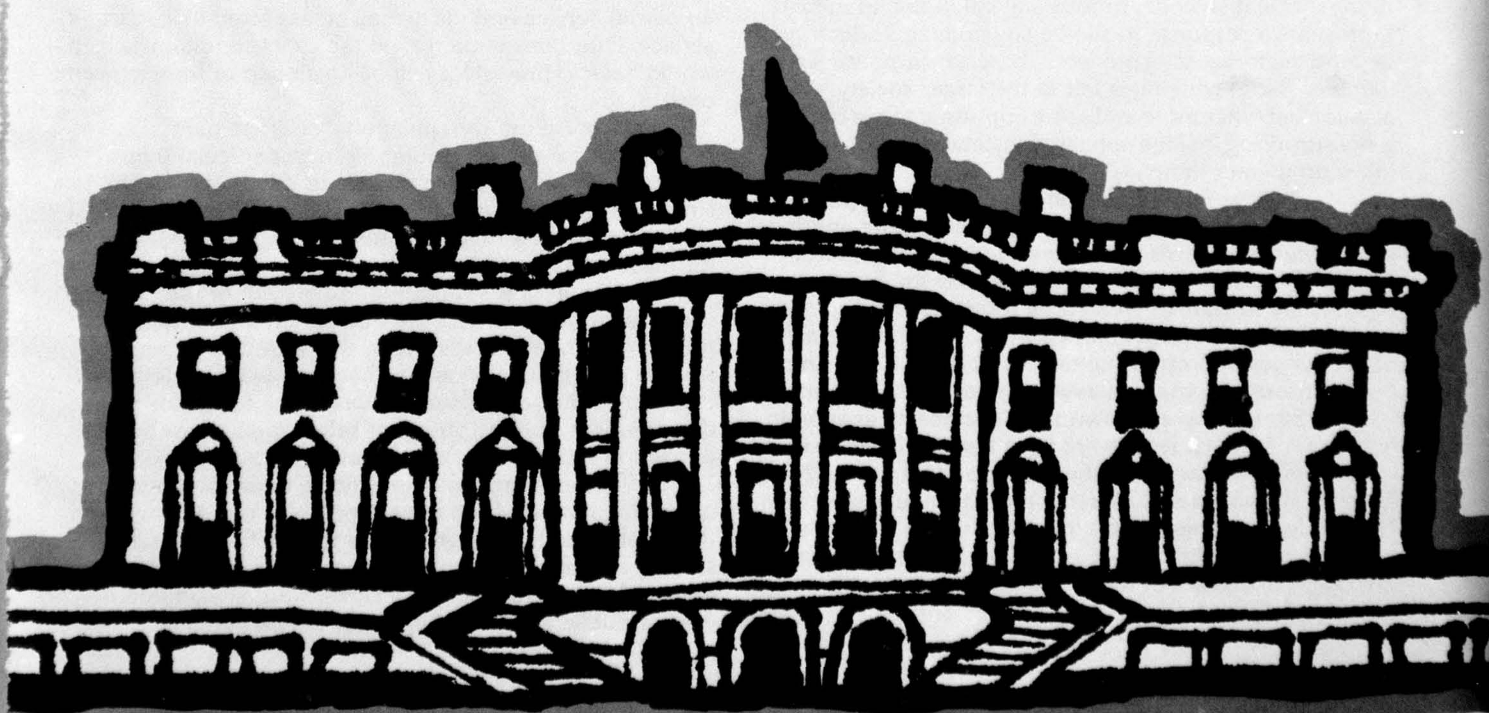
Aviation Activity	1979 Estimate	1991 Forecast	Average Annual Growth Rates (percent)	Growth (percent)
Air Carriers				
Revenue Passenger Enplanements (millions)	317.7	541.0	4.5	70.3
Revenue Passenger Miles (billions)	256.1	456.7	4.9	78.3
Commuter Carriers (millions)				
Revenue Passenger Enplanements	9.9	20.3	6.2	105.1
Revenue Passenger Miles	1226.8	2559.8	6.3	108.7
Air Cargo				
Revenue Tons Enplaned (thousands)	5201	11102	6.5	113.5
Revenue Ton Miles (millions)	13010	34630	8.5	166.2
General Aviation				
Fleet (thousands)	193.0	303.8	3.9	57.4
Hours Flown (millions)	39.0	64.0	4.2	64.1
Military				
Fleet	18623	19501	0.4	4.7
Hours Flown (thousands)	5090	5286	0.3	3.9
FAA Workload Measure				
Aircraft Operations (millions)				
Air Carrier	10.4	13.1	1.9	26.0
Air Taxi & Commuter	4.3	8.8	6.2	104.7
General Aviation	53.4	75.8	3.0	42.0
Military	2.5	2.5	—	—
Total	70.6	100.2	3.0	41.9
Instrument Operations (millions)				
Air Carrier	10.7	13.4	1.9	25.2
Air Taxi & Commuter	3.2	6.8	6.5	112.5
General Aviation	17.2	31.1	5.1	80.8
Military	3.7	3.7	0.0	0.0
Total	34.8	55.0	3.9	58.0
IFR Aircraft Handled (millions)				
Air Carrier	14.1	17.7	1.9	25.5
Air Taxi & Commuter	2.2	5.2	7.4	136.4
General Aviation	8.1	16.3	6.0	101.2
Military	4.8	4.8	0.0	0.0
Total	29.2	44.0	3.5	50.7
Flight Services (millions)				
Pilot Briefs	19.0	31.3	4.3	64.7
Flight Plans Originated	9.8	17.0	4.7	73.5
Aircraft Contacted	10.5	10.0	−0.4	−4.8
Total	68.1	106.6	3.8	56.5

Table 2
Summary of 1979 FAA Aviation Forecasts

Aviation Activity	Average Annual Growth Rate (percent) Historical 1974-1979	1978-1979*	Forecast 1979-1981	1979 1991	Total Growth (percent) Historical 1974-1979	Forecast 1979-1981	1979-1991
Air Carriers							
Revenue Passenger Enplanements	8.8	19.1	5.7	4.5	52.7	11.6	70.3
Revenue Passenger Miles	9.2	17.0	6.1	4.9	55.2	12.5	78.3
Commuter Carriers							
Enplanements	10.5	12.5	7.8	6.2	65.0	16.2	105.1
Revenue Passenger Miles	14.1	22.9	4.3	6.3	93.6	8.8	108.7
Air Cargo							
Revenue Tons Enplaned	3.6	6.4	7.0	6.5	19.4	14.5	113.5
Revenue Ton-Miles	6.5	8.5	9.2	8.5	37.2	19.3	166.2
General Aviation							
Total Aircraft	4.7	4.7	5.4	3.9	25.7	11.0	57.4
Hours Flown	4.9	5.1	6.0	4.2	27.0	12.3	64.1
FAA Workload Measure							
Aircraft Operations							
Air Carriers	1.8	3.0	2.4	1.9	9.5	4.8	26.0
Air Taxi & Commuter	12.4	13.2	7.8	6.2	79.2	16.3	104.7
General Aviation	4.8	5.1	4.8	3.0	26.5	9.7	42.0
Military	—	—	—	—	—	—	
Total	4.5	5.1	4.4	3.0	24.3	9.1	41.9
Instrument Operations							
Air Carrier	2.4	2.9	2.3	1.9	12.6	4.7	25.2
Air Taxi & Commuter	18.0	3.2	9.0	6.5	128.6	18.8	112.5
General Aviation	13.3	5.5	15.6	5.1	87.0	33.7	80.8
Military	1.6	0.0	—	—	—	—	—
Total	7.6	3.9	9.5	3.9	44.4	19.8	58.0
IFR Aircraft Handled							
Air Carrier	2.6	3.7	1.8	1.9	13.7	3.6	25.5
Air Taxi & Commuter	14.9	15.8	10.8	7.4	100.0	22.7	136.4
General Aviation	9.7	3.9	9.5	6.0	58.8	19.8	101.2
Military	2.2	2.1	—	—	11.6	—	—
Total	5.0	3.9	4.5	3.5	27.5	8.9	50.7
Flight Services							
Pilot Briefs	4.3	3.8	5.1	4.3	23.4	10.5	64.7
Flight Plans Originated	4.7	7.7	7.9	4.7	25.6	16.3	73.5
Aircraft Contacted	1.2	2.9	2.4	−0.4	6.1	4.8	−4.8
Total	3.9	4.9	5.5	3.8	21.2	11.3	56.5

*12 months ending September 30, 1979 over 1978 based on preliminary data

Chapter 1: A Foundation for Growth



The relationship between the aviation community and the general society is changing. The airline industry is mature. The Congress recognized this in passing the Airline Deregulation Act of 1978. The industry no longer needs the degree of protection it once enjoyed. Public perception of flight also has changed considerably. From the passing curiosity it engendered 76 years ago, aviation today is viewed increasingly as a necessary means in the Nation's pursuit of commerce and pleasure. General aviation (business and private flying) is becoming increasingly sophisticated with more than half of all operations having a business orientation.

A necessary utility, rather than a luxury, aviation is now subject to the same pressures as other major industries in the United States. Diverse policies, environmental and economic conditions increasingly affect action taken within the aviation community. Participants at recent aviation forecasting conferences, seminars and workshops sponsored by the Federal Aviation Administration, Office of Aviation Policy, have addressed this transformation. Concerns and recommendations presented by all segments of the community at these sessions are incorporated, whenever possible, in the series of aviation forecasts developed and published by the Office of Aviation Policy.

The aviation forecasts presented in this volume are developed annually and reflect the experience and the change in expectations of the preceeding year. The record of accuracy for this series of annual forecasts is documented in Appendix A. However, the accuracy of any forecast decreases as the length of time between the present and the forecast period increases. Awareness of issues which may influence the future path of aviation is a requirement for the forecaster, as it is for all who employ these forecasts in planning and managing the future of the aviation community.

Representative Issues. The discussion of this chapter focuses on some issues of both immediate and more speculative concern to the aviation community. It represents a response to the voiced concerns which go beyond the forecasting process. These concerns reflect many of the uncertainties felt in the larger society. As aviation becomes more and more important to the Nation, it is not surprising that the impact of societal issues on aviation takes on greater dimensions.

Actions taken by private individuals, corporate planners and managers, as well as Federal, state and local governmental officials determine the track of aviation growth. Forecasting predicts reactions by the aviation community to change created by forces external to the community. It does not create growth. The transformation of challenges into opportunities for growth occurs among the sponsors and users of aviation across the Nation.

Sample issues drawn from the policy, economic and environmental realms are used here to illustrate some of the challenges facing aviation today and tomorrow. Many factors exist which make seeing into the future uncertain. Not the least of these is the impact of world affairs on the cost and availability of fuel. However, just as the past is prologue, the issues of today are the foundation for tomorrow's growth.

Aviation has a proud history of overcoming challenges. Its growth to date and its achievements in safety are evidence of its ability to create better services in response to changing needs. Thus, the question is not whether aviation will grow, but rather how rapidly it will achieve new levels of activity.

Policy Issues

The dominant policy issue today is the change in Congressional intention reflected in the Airline Deregulation Act of 1978. This Act contemplated some major changes in commercial aviation. Some of these changes were foreshadowed by actions taken by the Civil Aeronautics Board prior to passage of the Act. Eased market-entry and more flexible fare provisions have already produced marked benefits to the industry and to the consumer. Many individuals have had the opportunity to fly in the past year who otherwise might not have flown without the stimulation provided by deregulation.

Commercial Aviation. Deregulation gives the air carriers greater opportunity to maximize load-factors, the percentage of aircraft seats occupied during a given flight. Thus, it is possible to theorize that the airlines might adopt a strategy of reducing flight frequencies to larger markets as well as smaller ones in order to maintain high load-factors in more markets. Alternatively, airline strategy may call for maximization of both load-factor and frequency through improved matching of equipment to markets. New aircraft, now under development, further increase the airlines' range of options in chosing their responses to market needs. Thus, corporate policies are likely to become an increasingly more important input to predictions of future events in the National Airspace System.

The effect of deregulation on smaller communities is still uncertain. A part of the freedom to enter new markets is the freedom under certain conditions to exit from other markets. Some cities have already experienced a decline in air carrier service and more may be expected to lose trunk service. Questions remain as to the exact conditions which would have to prevail for exit by an air carrier from a given market.

The Airline Deregulation Act offers new possibilities for the commuter airlines, particularly by encouraging service to smaller cities. Given the much smaller size of the commuter airlines' equipment, marginal air carrier markets may represent significant opportunities for these smaller carriers.

Congress is supporting the growth of the commuters by extending the equipment loan guarantee program to them. Furthermore, the subsidy program for smaller communities now has become available to these carriers. At the same time, Congress has asked for the development of more stringent safety regulations to be applied in this segment of commercial aviation.

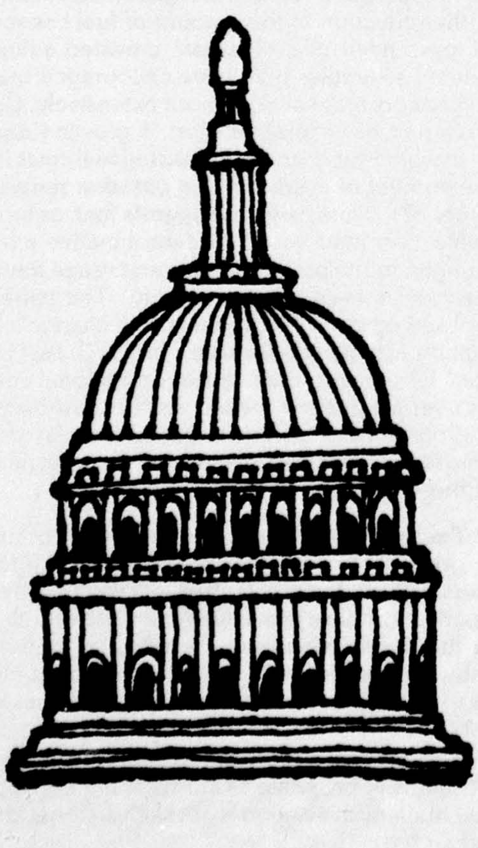
These Congressional actions, commuter adoption of existing markets from the airlines, plus growing demand for scheduled short-stage service should foster greater stability among the commuter airlines over the long term. As their stability increases, these carriers are likely to gain greater public acceptance for their smaller aircraft.

In the long run, it is possible to foresee the development of commercial aviation to the point where service to the Nation attains much greater efficiency and convenience. Denser markets would be served by the larger capacity of the trunk and local service carriers while the commuters extend the comprehensiveness of services through coverage of the smaller markets. Factors such as increased competition, higher costs and more effective use of equipment, all work to encourage these developments.

The Airline Deregulation Act of 1978 is an important event in the development of aviation in the United States. It diminishes the Federal role in the commercial aspects of aviation. By accomplishing this, the Act creates a wide range of opportunities for the actual providers of service in the private sector.

General Aviation. The largest sector of aviation in terms of flight operations is general aviation—personal flying for business or pleasure. Deregulation has no direct effect on these operations. However, the growth of personal flying is likely to be supported by development of improved and new reliever airports.

The second, third and fourth busiest Federal Aviation Administration towered airports in the Nation—Santa Ana, Long Beach and Van Nuys, California—have achieved their status with very little or no airline operations. Only Chicago's O'Hare handles more operations than these airports. General aviation, with 53.4 million operations at towered airports plus additional flights at smaller fields, has an impact on many more cities and towns than does commercial aviation. The utility and attraction of general aviation derives from its convenience and access to a greater number of airports. Not only does this traffic have a profound effect on Federal policy, it requires attention at the local level as well.



Federal concern for general aviation and the other sectors of aviation is expressed through actions to improve safety throughout the National Airspace System. The Air Traffic Control System has evolved and grown over the past 40 years in response to the safety and service needs of the entire aviation community. Regulations which allow this sytem to serve the changing needs and increasing activity of the flying public continue to evolve in the interest of improving safety and convenience. Terminal Control Areas exist today around 23 airports. Originally developed in response to the increasing density of traffic surrounding the busiest airports, the Terminal Control Area system has significantly lowered the incidence of near-misses at airports where the system exists. More importantly, no mid-air collisions have ever occurred in Terminal Control Areas.

Current rulemaking proposals call for the creation of Terminal Control Areas at four additional airports. Changes to regulations, such as that currently proposed, can be the result of public demand as well as the safety and convenience requirements of the aviation community. The growing importance of aviation to the public suggests that the demands for regulatory action and the impact of these actions may well increase in the future.

Local policy. Policy decisions at the state and local levels also can have a tremendous impact on aviation development and use within these jurisdictions. For example, land-use policy is a local issue of increasing National concern as the amount of traffic at the most frequently used airports approaches the airports' capacity to accommodate the traffic.

Today, four airports — National in Washington, D.C., LaGuardia and J.F. Kennedy in New York, and O'Hare in Chicago — have to operate with some restrictions on arrivals and departures due to excess demands. Over 20 airports are likely to increase their levels of activity to the point of requiring such restrictions during the next 12 years. Cleveland's Hopkins Airport, Los Angeles International Airport, as well as other airports which were originally built beyond urban and suburban limits now find themselves surrounded by urban development. Increased load-factors, use of larger capacity aircraft and development of reliever airports tend to push this air side capacity problem further into the future at any given airport. But this issue remains a concern whenever the future of aviation and its support facilities is evaluated.

Land side capacity also may join air side congestion as a policy problem for municipal and state planners. Los Angeles International Airport is already experiencing land side capacity problems. It takes five times longer for the typical trip to the airport during peak hours than it takes during off-peak hours. One implication is that the constraints imposed by present land side access preclude passenger enplanement growth beyond 20 million enplanements per year at this airport.

Development of reliever airports is one logical response to the capacity problem. But upgrading smaller airports and developing new airports to serve as relievers to major airports represent major challenges to the affected

communities. Growth in aviation is more than just growth in air carrier traffic. Air taxi, commuter and general aviation activity is growing as well. More important to airport-community relations, the latter activity is localized in nature rather than transient. Thus, community policy decisions tend to influence these types of activity more than that of the larger air carriers.

Today, and increasingly in the future, airport development is a municipal, regional and state concern, as well as a concern involving the Federal Government. Competition in regard to land-use, limited governmental resources and quality-of-life issues surround most attempts to develop increased aviation capacity.

The convenience and benefits of air travel ensure that aviation has the resources to participate on an equal footing with other interests in this competition. Perhaps the greatest challenge inherent in the competition is the opportunity presented by the scarcity of resources. Interaction among aviation and other planners, representatives of the transportation industries, and the consuming public should lead to increased transportation integration. Scarce transportation resources can be applied most effectively through such integration. The benefits accrue to the entire Nation.

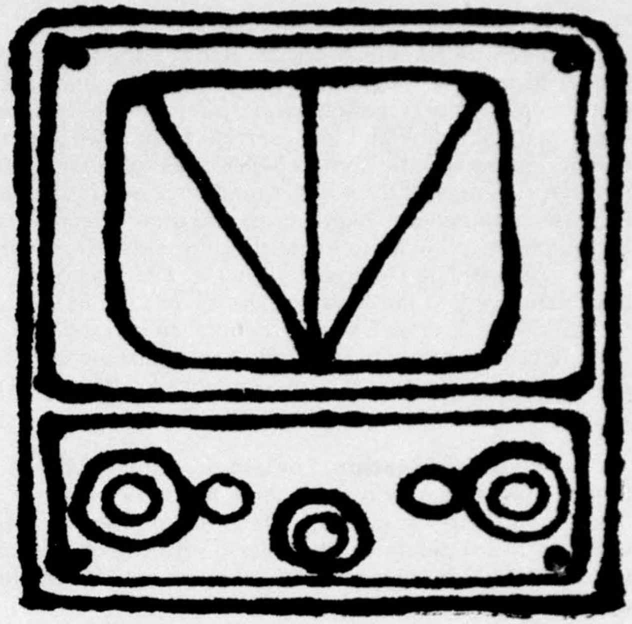
As efforts develop to enhance the melding of different transportation modes at individual cities, states and regions, a little noted consequence of deregulation may become more important. The requirement for submission of air carrier operating data to the Federal Government expires in five years with the abolition of the Civil Aeronautics Board. Those reporting requirements are the basis of the air carrier forecasts presented here and of much of the planning occurring at airports and in communities across the Nation. However, they represent a considerable financial burden to the air carriers that provide most of the data. It is not yet known how the data will be collected and made available for planning purposes after 1984.

In summary, the aviation community at all levels of operations faces a broad range of issues which fall within the policy arena. Some of these may be anticipated today. Others are sure to manifest themselves as current uncertainties become the foundations for opportunities accepted in the future.

Economic Issues

The twenty-first century is only 21 years away. Five years away is 1984. Many certainties once widely shared of what would happen by these milestone years are now questioned. Economic assumptions, like many other assumptions, are subject to the uncertainty of differing perspectives. In the larger arena, inflation and unemployment now seem to follow parallel patterns. The challenge of responding within the many uncertainties of today exists for aviation as it does for all other sectors.

Fuel Costs. The changing and uncertain energy picture may represent an opportunity as well as a burden to aviation. Certainly the consequences of sharply rising fuel costs have not proven to be what might easily have been predicted in 1972. For example, the number of hours flown by general aviation aircraft should have been negatively affected by the fuel price rise and the recession of 1974. In fact, general aviation aircraft now are flying 37 percent more



hours than they did in 1973. This is a departure from the previous four years when general aviation activity remained stable.

The airlines have also responded positively to the challenge of higher costs. On a revenue passenger mile basis, the airlines are using only 70 percent as much fuel today as they did six years ago.

Deregulation is responsible for at least a portion of the recent rise in passenger traffic. The increase in average number of seats per aircraft and higher load-factors help to explain the reduction in the amount of fuel consumed per revenue passenger mile. However, crowded airliners and more limited schedules may have encouraged business flyers to use corporate aircraft more extensively. Corporate aviation, a part of general aviation, is growing rapidly.

In what way, then, do escalating fuel costs influence the development of aviation? The question remains open. The history of the last six years suggests that, as long as fuel is available, cost may not be as determinative a factor as once thought. In the past, fuel costs and usage have served as stable indicators of aviation activity. The pattern of growth observed since 1973 points to a change in the fuel cost-aviation activity relationship. In 1973, fuel cost represented 12 percent of air carrier operational costs. The figure is over 20 percent today. As fuel cost becomes a greater proportion of air carrier costs, it is reasonable to expect more individualized responses to market needs from each of these carriers.

Technology. A recent surge in sales of turboprop aircraft, primarily to corporate and commuter airline customers, reflects the greater fuel efficiency of these aircraft in comparison to pure jets. Given the relatively short stage lengths, the distance between takeoffs and landings, of corporate and commuter flights, the turboprop aircraft appears to be an excellent compromise between speed and fuel costs.

With the many uncertainties which accompany life today, it seems appropriate to surmise that the application of new technology in aviation is not likely to forge ahead as it

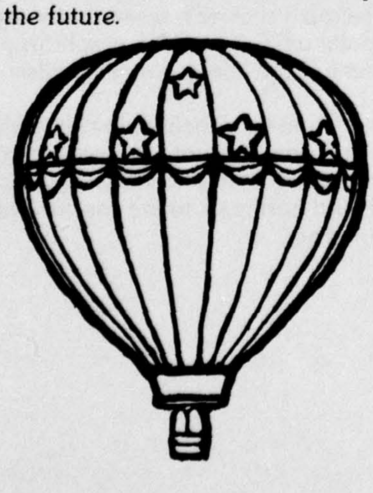
has in the past. Cost, fuel efficiency, and environmental concerns foster new technology today. The glamour of new technology is more incidental to development. Instead of moving steadily toward the highest possible technology, aviation seems to be adapting to the specific demands imposed by differing utilization patterns. The re-emergence of the turboprop, once thought to be only a technological transition between the piston and jet engine, suggests again a growing diversity in the marketplace. The search for new technology has become focused in areas such as the development of microprocessor based controls which improve fuel efficiency.

Air Cargo. The use of aviation for transport of cargo has a history extending back to the early air mail service. It predates passenger transport. Over five million tons of cargo are carried by cargo and passenger airlines today.

The loan guarantee program has been extended to include nonconvertible cargo aircraft as well as the commuter aircraft. Airport Development Aid Program funding formulas have been revised to incorporate some of the terminal and other land-side costs. The improved facilities and lowered interest charges encouraged by these developments — plus the growing market for air cargo — suggest that the growth limits of air cargo have not been achieved. It is an opportunity with seeming great potential awaiting exploitation.

So far, this discussion has focused on some economic issues which are of concern primarily to service providers. Inflation, credit availability and service availability are some of the concerns facing consumers. Policies to constrain consumer credit are discussed periodically. Air fares typically are paid with credit. Thus, implementation of consumer credit restraints might have a negative impact on air travel. On the other side, the rise of the multiple income family with fewer children might make more resources available for pleasure trips.

Challenges to the economy of flight seem to be proliferating. Overcoming these, and future, challenges represent opportunities for growth to the aviation community. The extension of loan guarantees and subsidies to a wider segment of the community encourage a more diverse future market place. Forecasters and planners must recognize the likelihood of new service responses in visualizing the future.



Environmental Issues

Noise and pollution have become issues in aviation more recently than in many other industries. But the concern, as in other industries, is not a transient one. Environmental awareness and protection are additional factors the aviation community now must consider in developing its strategies for future growth.

Environmental Impact. The requirements of environmental impact statements, mandated under the National Environmental Policy Act, adds a new element in facility and operational planning. Community expressions of environmental concerns are already having an impact on the release of Airport Development Aid Program funds. At the moment, the effort expended on environmental planning and development of environmental impact statements appears to be a financial burden on many parts of the aviation community. The demand for environmental impact statements can only increase. Even the deregulation actions of the Civil Aeronautics Board and the forecasts of the Federal Aviation Administration have come under judicial scrutiny. However, the costs and delays associated with industry-community litigation are ones which may be avoided in the future through greater planning sophistication.

Construction and equipment delivery lead-times are getting longer in the aviation field as they are for large scale projects everywhere. Airports and aviation service facilities are growing in size and complexity. The capacity limitations of major airports tend to increase the demand for air transportation at other facilities. At the same time awareness of possible negative effects of such facilities is growing among concerned individuals and groups. Consequently, the potential for conflict is present today and only can become more pronounced in the future.

The aviation industry has a history of adapting to new demands. The transition to jets and the accommodation to wide-bodied aircraft are two examples. Environmental issues, demands and remedies related to aviation are still in the process of evolving. It is reasonable to expect that this particular concern will join other concerns which in the past have been dominant issues and are now part of standard procedures.

Environmental concern also represents an opportunity for the aviation community. The responses of other industries to these concerns often imply greater utilization of air service. Many industries and individual companies are dispersing their manufacturing plants and operations across the country. The chemical and automobile industries are two examples of this phenomenon. As this trend continues, the demand for both air travel and air cargo is likely to increase. The most likely beneficiaries of this new activity may well be newly emerging commuter airlines.

Night Operations. Night time airport closings pose a different kind of problem. Encroaching suburban communities usually precipitate these closings. They are the results of political pressure brought to bear on municipal and airport authorities.

Airport capacity lost to those closings may be permanent. An airport which is closed contributes no noise to the community. So, even the development of quieter

engines may not be sufficient to reverse such closings as lack of noise is preferable to any new lower decibel levels. This contrasts with other environmental issues. New technologies and improved planning can foresee or overcome many problems. But, since aviation can not be silent, remedial action on closings is more difficult to achieve politically.

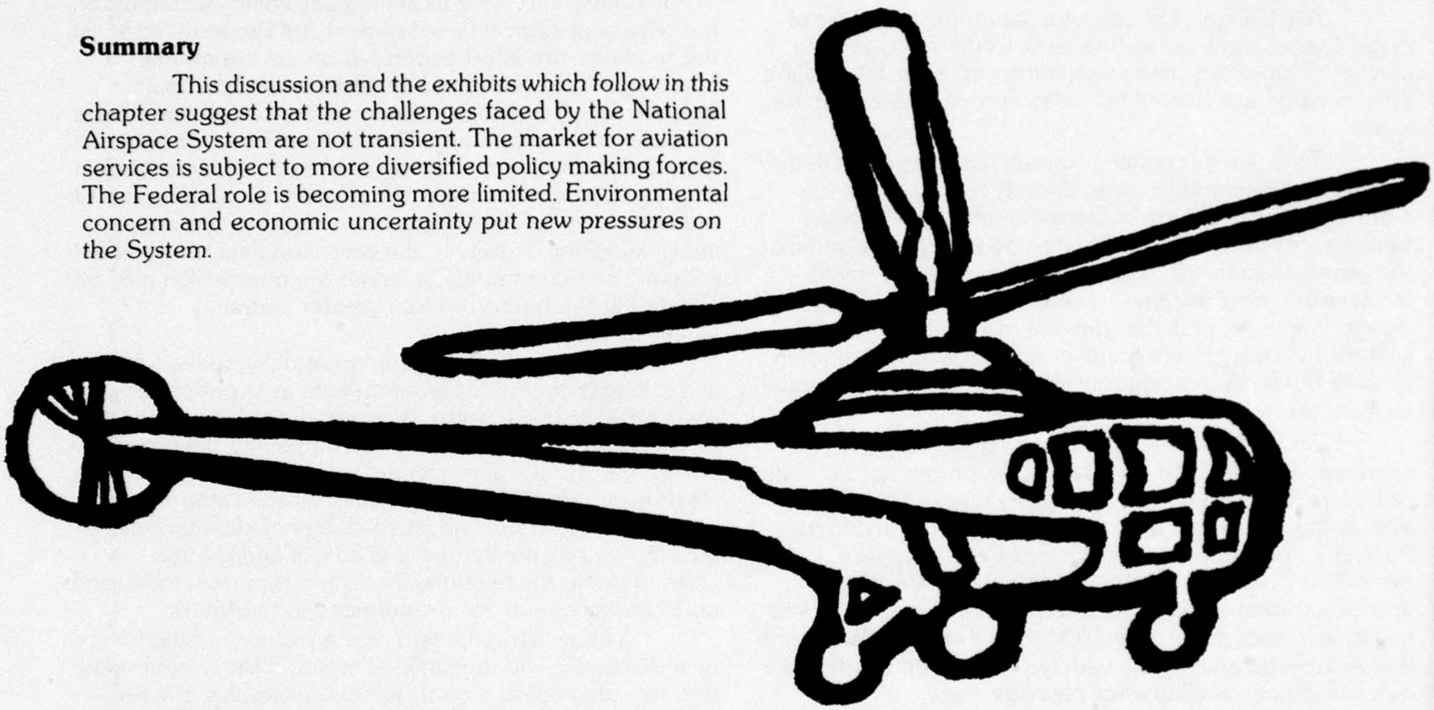
Conflict is a natural consequence in any area where demand approaches or exceeds acceptable limits. Aviation is a part of the environmental conflict. The overall conflict is one where, in the long run, aviation can gain many new opportunities for service.

Summary

This discussion and the exhibits which follow in this chapter suggest that the challenges faced by the National Airspace System are not transient. The market for aviation services is subject to more diversified policy making forces. The Federal role is becoming more limited. Environmental concern and economic uncertainty put new pressures on the System.

Aviation planners and forecasters must provide the initial response to these forces of change within and surrounding aviation. The realm from which planning inputs are derived is expanding. The National Environmental Policy Act and more localized environmental legislation demand new sensitivity and foresight. In addition to these changes, planners must confront the challenge posed by longer lead-times for projects in an environment where future events are arriving with shorter warnings.

Planning and forecasting must become more interactive. The impact of current and expected events must be assessed continually against current forecasts and plans. The Federal Aviation Administration's annual forecast presented here incorporates the changes mandated by National events. Flexibility and heightened responsiveness among forecasters and planners throughout the aviation community are increasingly evident. The challenges posed by current demands on aviation suggest that forecasting and planning no longer can be a fixed-cycle activity. They must employ an on-going, rolling process. Future opportunities require this interactive response.



The Exhibits

This chapter addresses issues that have important consequences for aviation in the United States. The resolution of these issues will certainly pose challenges to the aviation community. As at all times, changes growing out of the issues will create new opportunities in aviation as well as in other endeavors.

The exhibits present four indicators of change occuring in demography and investment patterns of the country. The patterns of growth they represent show definite change. As aviation continues to grow, these and other basic phenomena must be taken into consideration by the aviation community in planning for its own future well-being.

Exhibit 1 projects the effects of a declining birth rate on the total population. Perhaps of greater concern to those in aviation is the rapid change foreseen in the age composition of the population. Exhibit 2 is a graphic representation of the movement of the "baby boom" children through adulthood.

Exhibits 3 and 4 are included as an index of the shift of population and employment, as measured by growth rates of certain metropolitan areas and capital investments, from the north and northeast to the southern and western parts of the country.

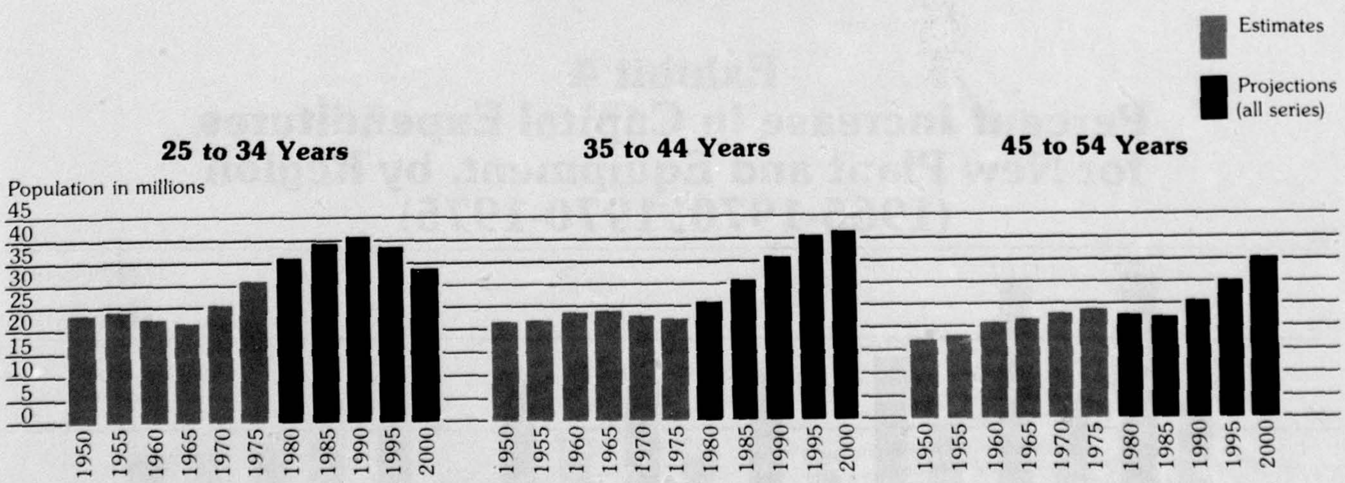
Exhibit 1
Estimates and Projections of Total Population: 1930-2025

(in thousands)

Year	Series 1	Series 2	Series 3
Historical			
1930		123,188	
1940		132,594	
1950		152,271	
1960		180,671	
1970		204,878	
Projections			
1980	224,066	222,159	220,732
1990	254,715	243,513	236,264
2000	282,837	260,378	245,876
2010	315,248	275,335	250,892
2020	354,108	290,115	253,011
2025	373,053	295,742	251,915

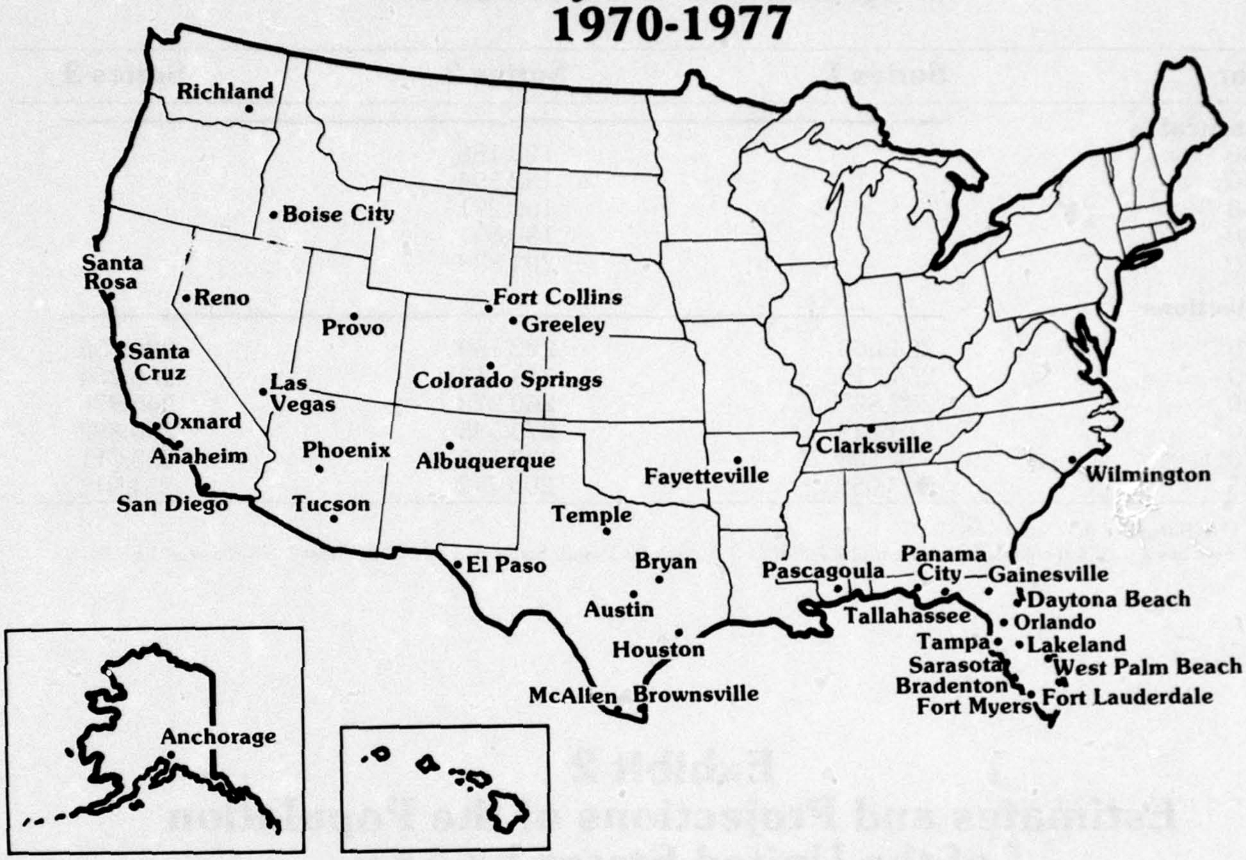
Source: U.S. Bureau of the Census, 1977
Series 1 assumes a total fertility rate per woman of 2.7; Series 2, a rate of 2.1; and, Series 3, a rate of 1.7. The 1978 rate was 1.8.

Exhibit 2
Estimates and Projections of the Population of the United States by Age: 1950 to 2000



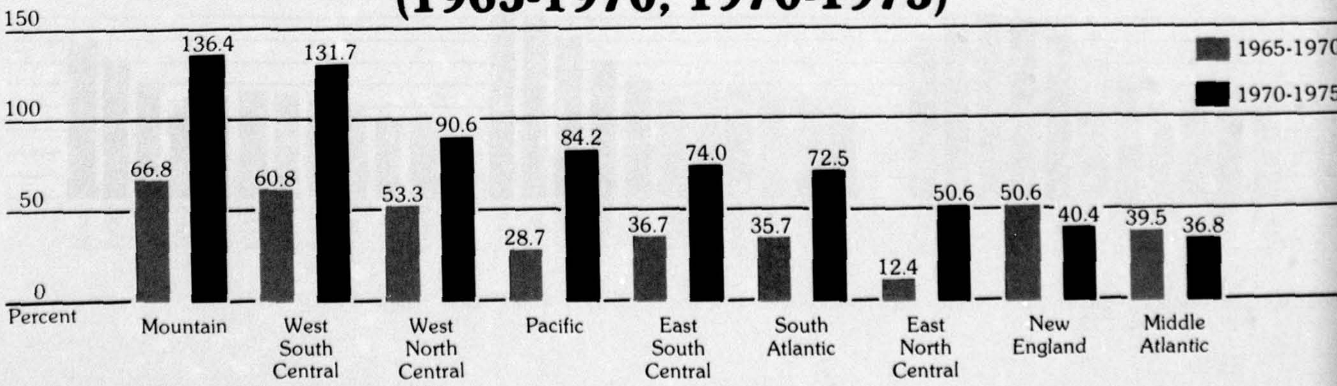
Source: U. S. Bureau of the Census, "Projections of the Population of the U. S.: 1977-2050," CPR Series P-25, No. 704, 1977

Exhibit 3
Metropolitan Areas with Population Increases of Twenty Percent or More 1970-1977



Source: U.S. Bureau of the Census, unpublished data

Exhibit 4
Percent Increase in Capital Expenditures for New Plant and Equipment, by Region (1965-1970, 1970-1975)



Source: Annual Survey of Manufacturers, 1976
1972 Census of Manufacturers

The FAA Forecasting Initiative

The Federal Aviation Administration's Office of Aviation Policy is in the third year of an initiative to strengthen the utility of its forecasts for managers and planners throughout the aviation community. Begun in 1977, the initiative is designed to foster interaction among forecasters and forecast users in the industry, at all levels of government and among the interested public. The principal vehicle used for this interaction is a series of conferences, seminars and workshops which address specific topics in forecasting.

Commentary received through these vehicles over the past three years indicates that Federal Aviation Administration aviation forecasting is becoming increasingly responsive to aviation managers and planners. The substance of this commentary is summarized below:

User Oriented Specificity. The Federal Aviation Administration requires predictions of its future workload for planning and budgeting purposes. Answering this need is the primary motivation behind the series of aviation forecasts published by the Administration. Certain forecast outputs are fixed by this requirement. However, other outputs which are of high utility to forecast users outside the Federal Government often can be incorporated in these forecasts.

The need of many users to identify traffic is reflected in the more recent forecasts. Special attention is being given to the development of more precise general aviation and commuter operations forecasts. The major problem still associated with these forecasts is that estimation, not actual counts, is the basis for a large portion of the data base. Traffic reporting from non-towered airports is not very reliable. The regionally based General Aviation Systems Dynamic Model is being tested in the New England Region, Oregon and Texas. It appears capable of overcoming some of these data base problems.

Geographic disaggregation is an issue posed by many forecast users. Because there are over 14,000 airports in the United States, complete disaggregation would constitute an undue burden on the National forecasting effort. However, almost 90 percent of aviation passenger traffic is experienced within 85 major hubs. Individualized hub forecasts are being developed for the 25 largest hubs. The individualized forecasts for Atlanta, Chicago, Los Angeles, Dallas, Miami, San Francisco, Denver, Honolulu, Houston, Philadelphia, Seattle, Tampa, and Kansas City are completed. Forecasts for the New York, Washington, Boston, Detroit, Pittsburgh, St. Louis, Minneapolis, Las Vegas, Cleveland, New Orleans, Phoenix, and Memphis hubs will be completed in fiscal year 1980.

Aggregation. The benefits of top-down versus bottom-up forecasting have been a major topic in the commentary received by the Federal Aviation Administration. The issue lies in the fact that it is difficult to reconcile locally generated forecasts with the top-down "disaggregated" National forecasts.

Workshops scheduled approximately 12 times per year are specifically designed to overcome this problem. Discussion at these workshops includes the assumptions and weights assigned to model variables from which the forecast differences often result.

Event Impact Analysis. Many forecast users have expressed difficulty in planning from a single "most likely" combination of future events. The Federal Aviation Administration has responded to this problem by bracketing its National forecast within alternative scenarios. These alternative forecasts incorporate events which can be reasonably expected to happen during the forecast period under a range of different circumstances.

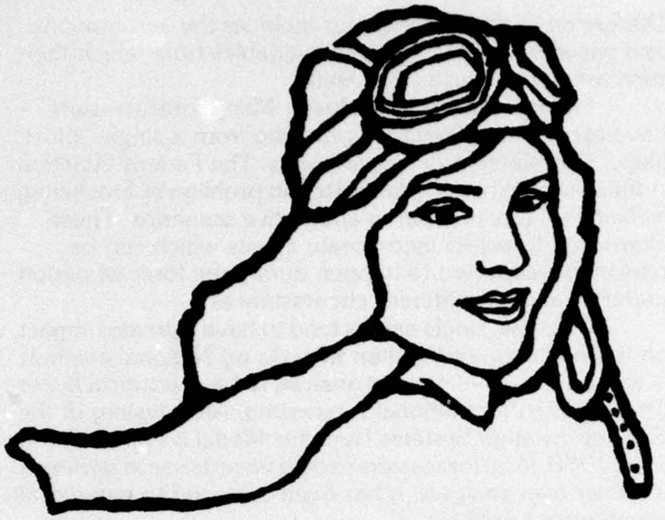
Overall, single events tend to have a greater impact on local aviation traffic than they do on National aviation activity. Thus, event impact analysis is a more critical factor for local than for National forecasting. After testing of the General Aviation Systems Dynamic Model is completed in June 1980, local forecasters should have its use in performing their own analyses. It has been designed to incorporate event impact analysis.

The FAA Forecasting Role. A strongly expressed opinion has been that the Federal Aviation Administration forecasting effort not replace or duplicate other forecasting operations. This topic will receive major attention in the seminars and workshops in the coming year. In part due to exposure created by the conferences, seminars and workshops of the previous years, sophistication in aviation forecasting has increased significantly across the country. Budgetary restraints within the Federal Aviation Administration serve as a powerful incentive for the efficient application of as much of this talent as possible. By the end of the year, it is expected that approximately 20 of the hub forecasts will be "on-line" and available for use by forecasters at the hub themselves. The effect of this development and the future availability of the General Aviation Systems Dynamic Model is to enhance the value of the aviation forecasting partnership between the Federal Aviation Administration and local forecasters.

1979 FAA Forecasting Focus

The many uncertainties decision makers face today place a special burden on the forecasting activities of the Office of Aviation Policy. Forecasting is the first step in planning under uncertainty. Consequently, concentration of forecasting effort will be placed on increasing mutual understanding among forecasters and planners on the purpose and limitations of forecasting, extension of state and local involvement in forecasting, and continued efforts on improving forecast accuracy.

The Outreach Program consists of the National FAA Forecast Conference, Hub seminars, regional workshops and consultations. The program provides the environment in which occurs much of the Office of Aviation Policy's interaction with the aviation community on forecasting. Heretofore, this interaction has stimulated the widely recognized improvements in the Federal Aviation Administration's technical forecasting capability. Significant future improvements in the forecasting process will come from the new emphasis the Outreach Program will place on making forecasting more interactive.



The Outreach Program is an highly effective vehicle for exploration of the assumptions, data inputs and utility of forecast outputs. It will be employed increasingly in the future to stimulate more forecasting activity at the state and local levels. This orientation is based on several factors.

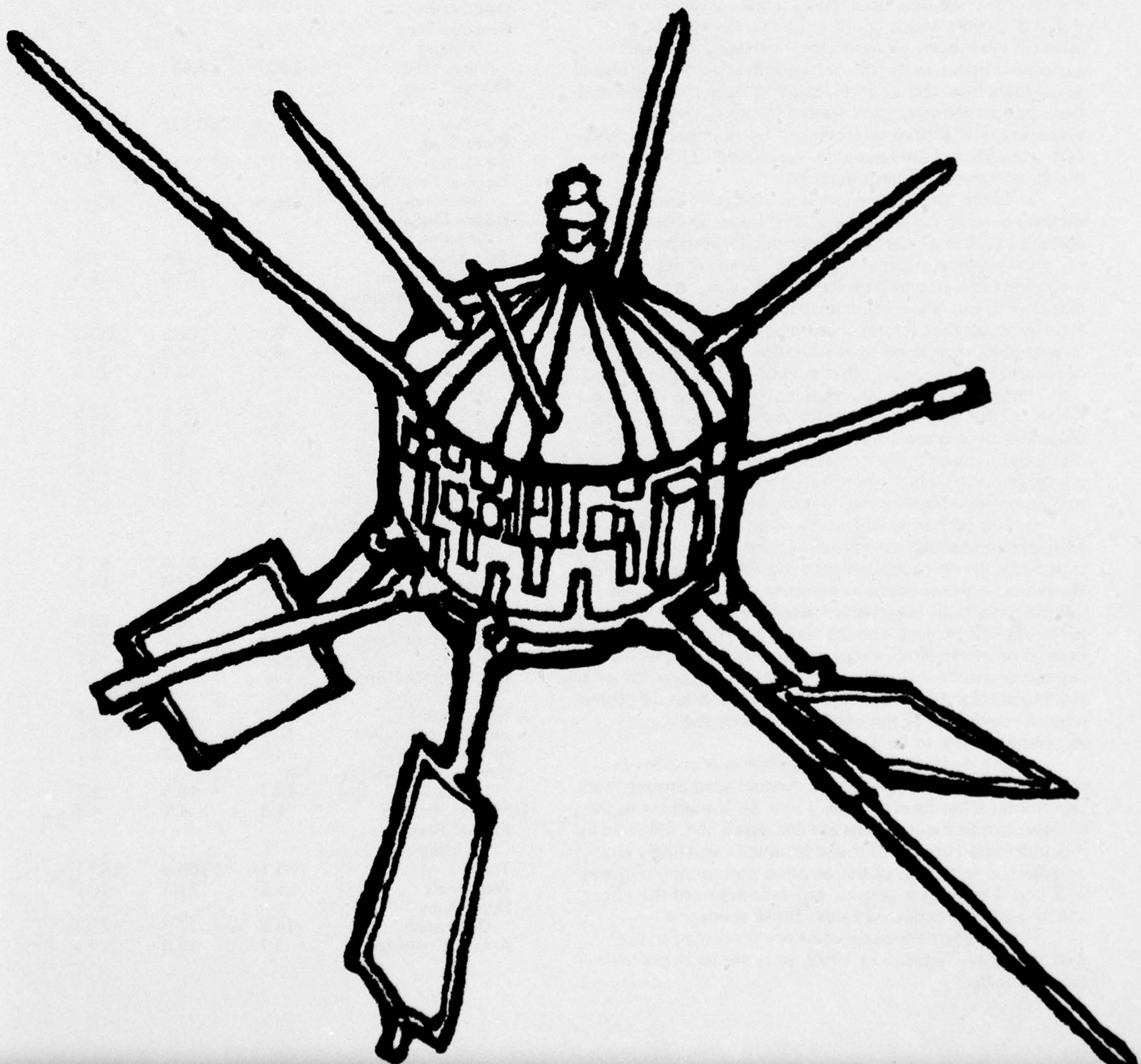
Local planners face a growing task as a result of events over which they have little or no control. Hands-on involvement in forecasting for their own locality will increase their awareness of the forces impinging on their operations.

Budgetary constraints are a fact of life not only within the Federal Aviation Administration but also at the state and local levels. As long as the data used in forecasting remains of uniformly high quality, shared development of actual localized forecasts will enhance planning efforts without causing cost duplication.

Ultimately, the interactive forecasting process may produce the highest standards of accuracy possible in forecasting. Awareness of potential future events and trends with significant effects on aviation are more likely to be discovered when multiple centers are involved in the forecasting process. Many of these events may be detected at the local level before they have an effect on National traffic patterns.

In another effort to increase the accuracy of the national forecast, the Office has commissioned a major evaluation of all factors and techniques currently applied to the national forecast. The results of this investigation will become available this year. Insights derived from it will be incorporated into the 1980 FAA Aviation Forecasts.

Chapter 2: Alternative Scenarios



A view into the future is necessarily less precise than one into the more comfortable past. Forecasting techniques employing historical relationships and expected events provide a controlled and rational basis for prediction of the future. However, since the future always is accompanied by uncertainty, predictions made of the future are best presented within a range of possible and plausible outcomes.

This chapter is an outline of what might be expected to happen within aviation if the Nation should experience either "rapid growth" or "stagflation" over the next 12 years, the forecast period. The resulting scenarios provide plausible range definitions for the intermediate "baseline" forecast presented in the following chapter.

These scenarios give a measure of perspective to the future. Their economic and societal assumptions are defined. Events which could influence the growth of aviation have been assessed for their likelihood and expected impact on the major trends in aviation. A group of individuals from the Federal Aviation Administration and from private industry participated in developing the scenarios. The formal processes of trend impact analysis and cross impact analysis were employed in the assessments and impact determinations.

Trend impact analysis is a computer-assisted method used to assess the effect of future events on variables such as air carrier operations. The process is based on events derived from an aviation literature review that may affect the growth patterns within aviation. Consensus judgements obtained on the probability of the occurrence of an event mark the first step in the assessment process. Cross impact analysis is used to modify the probability of the occurrence of an event if other events occur. The last step in trend impact analysis is assessment, again based on judgements, of the probability that an event will have a certain effect on an aviation variable. The product of the two methods is a trend line for a variable which incorporates the effects of events which cannot be accounted for with other projection techniques such as regression.

The scenarios which follow address the needs of planners and managers in the aviation community who may face decisions on capital projects involving long lead times. By example, the scenarios encourage the consideration of alternative actions based on views of the future which relate to the specific project. The scenarios are National in scope. Formal or informal scenarios developed in support of capital expenditures may use the National scenarios as a starting point to be modified to fit the economic and project related conditions of the context in which the capital expenditures are to be made.

The rapid growth and stagflation scenarios are presented in parallel to facilitate comparisons among them and the baseline forecast (see Table 3). Variations in the socioeconomic assumptions are discussed first, followed by the anticipated impact of these variations and likely events on selected segments of the aviation community. Figures 1, 2 and 3 provide a graphic representation of the effects which might be expected under these scenarios.

The alternative scenarios are presented in the past tense, as if written in 1992, in order to stress their conditionality.

Table 3
Alternative Forecasts For FY 1991

	Stagflation Society Scenario	Baseline	Rapid Growth Scenario
Scheduled Domestic Passenger Traffic			
Revenue Passenger Miles (billions)	330.2	364.5	443.4
Revenue Passenger Enplanements (millions)	458.0	499.8	599.1
Air Cargo Domestic			
Revenue Tons Enplaned (thousands)	5.551	8.483	12.478
Revenue Ton Miles (millions)	7.149	10.712	16.439
Fleet Size			
Air Carrier	2.970	3.164	3.354
General Aviation (thousands)	266.8	303.8	325.1
Hours Flown (millions)			
Air Carrier	7.9	8.4	8.9
General Aviation	54.4	64.0	70.0
Tower Operations (millions)			
Total	78.0	100.2	122.3
Itinerant	53.9	66.3	75.9
Air Carrier	12.3	13.1	14.0
Air Taxi and Commuter	7.8	8.8	12.9
General Aviation	32.6	43.2	47.8
Military	1.2	1.2	1.2
Local	24.1	33.9	46.4
General Aviation	22.8	32.6	45.1
Military	1.3	1.3	1.3
Instrument Operations (millions)			
Total	52.8	55.0	67.7
Air Carrier	12.6	13.4	14.3
Air Taxi and Commuter	5.6	6.8	12.4
General Aviation	30.9	31.1	37.3
Military	3.7	3.7	3.7
IFR Aircraft Handled (millions)			
Total Handled	38.9	44.0	49.7
Air Carrier Handled	16.8	17.7	18.6
Air Taxi Handled	4.2	5.2	7.1
General Aviation Handled	13.1	16.3	19.2
Military Handled	4.8	4.8	4.8
Flight Services (millions)			
Total	85.1	106.6	133.1
Pilot Briefs	25.5	31.3	40.2
Flight Plans Originated	14.2	17.0	21.3
Aircraft Contacted	5.7	10.0	10.1

Figure 1.
A Comparison of Economic Assumptions

1979
1986
1991

GNP	1979	1986	1991
Baseline	1423.4	1725.6	1978.6
Rapid Growth		1869.2	2373.8
Stagflation		1697.9	1886.2
Empl't (M)			
Baseline	96.0	107.0	113.6
Rapid Growth		109.7	119.7
Stagflation		103.5	107.4
CPI			
Baseline	210.6	343.0	445.9
Rapid Growth		327.0	415.1
Stagflation		351.9	495.3

DPI (B)	1979	1986	1991
Baseline	987.4	1171.2	1342.4
Rapid Growth		1291.5	1705.5
Stagflation		1120.8	1212.5
Oil & Gas Deflator			
Baseline	209.9	453.8	597.0
Rapid Growth		327.0	503.3
Stagflation		442.9	644.0

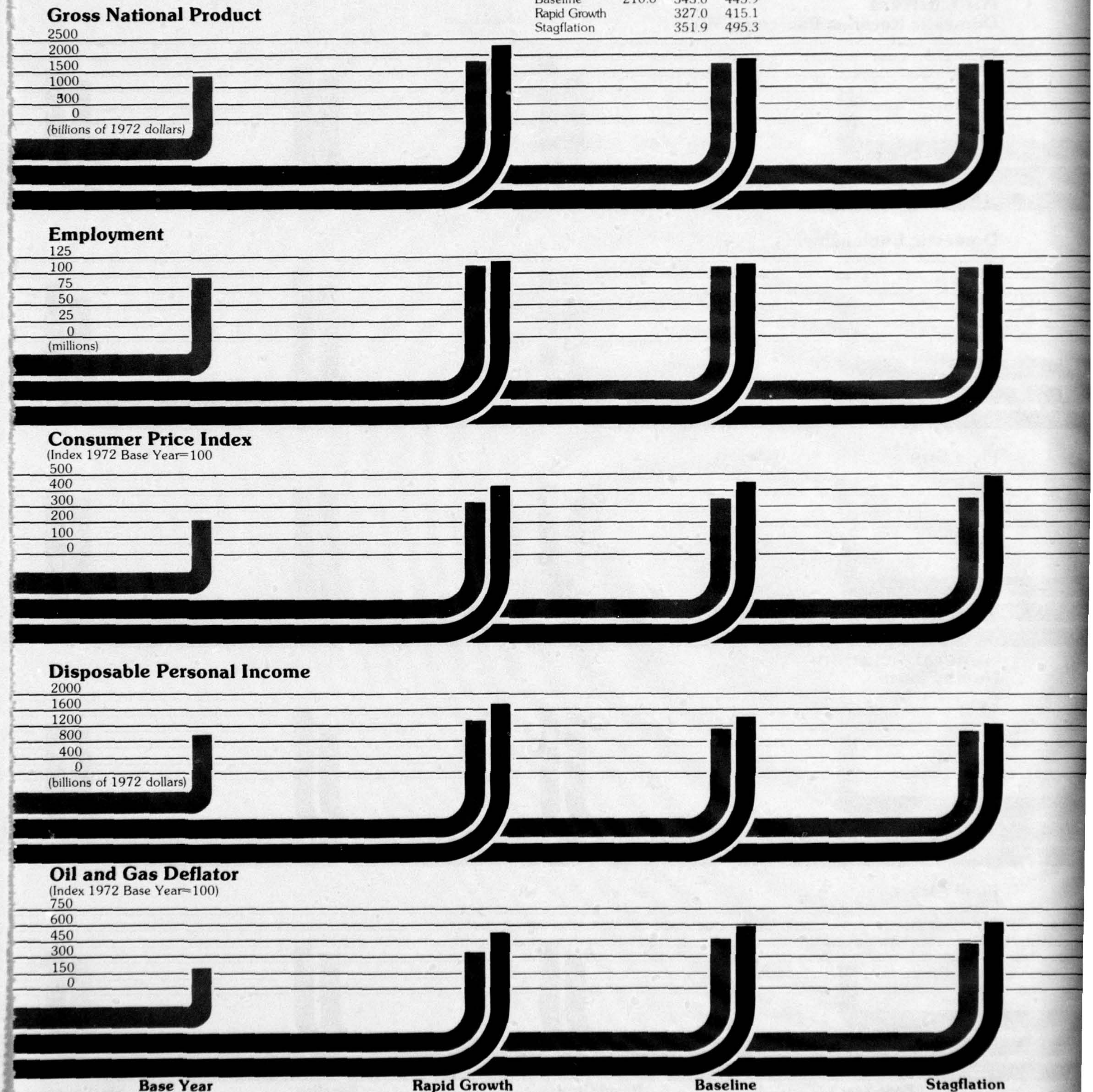


Figure 2.
A Comparison of Aviation Forecasts

1979
1986
1991

Air Carrier

	1979	1986	1991
RPM (M)			
Baseline	204.7	297.0	364.5
Rapid Growth		308.4	426.1
Stagflation		276.1	336.2
Enps. (B)			
Baseline	294.3	414.8	499.8
Rapid Growth		452.3	550.4
Stagflation		350.8	458.0
Fl't. Size (T)			
Baseline	2,623	2,914	3,164
Rapid Growth		3,099	3,354
Stagflation		2,735	2,970

GA

Hours Flown (M)	*1979*	*1986*	*1991*
Baseline	39.0	54.6	64.0
Rapid Growth		60.0	70.0
Stagflation		46.4	54.4
Fl't. Size (T)			
Baseline	193.0	266.7	303.8
Rapid Growth		273.5	325.1
Stagflation		251.7	266.8

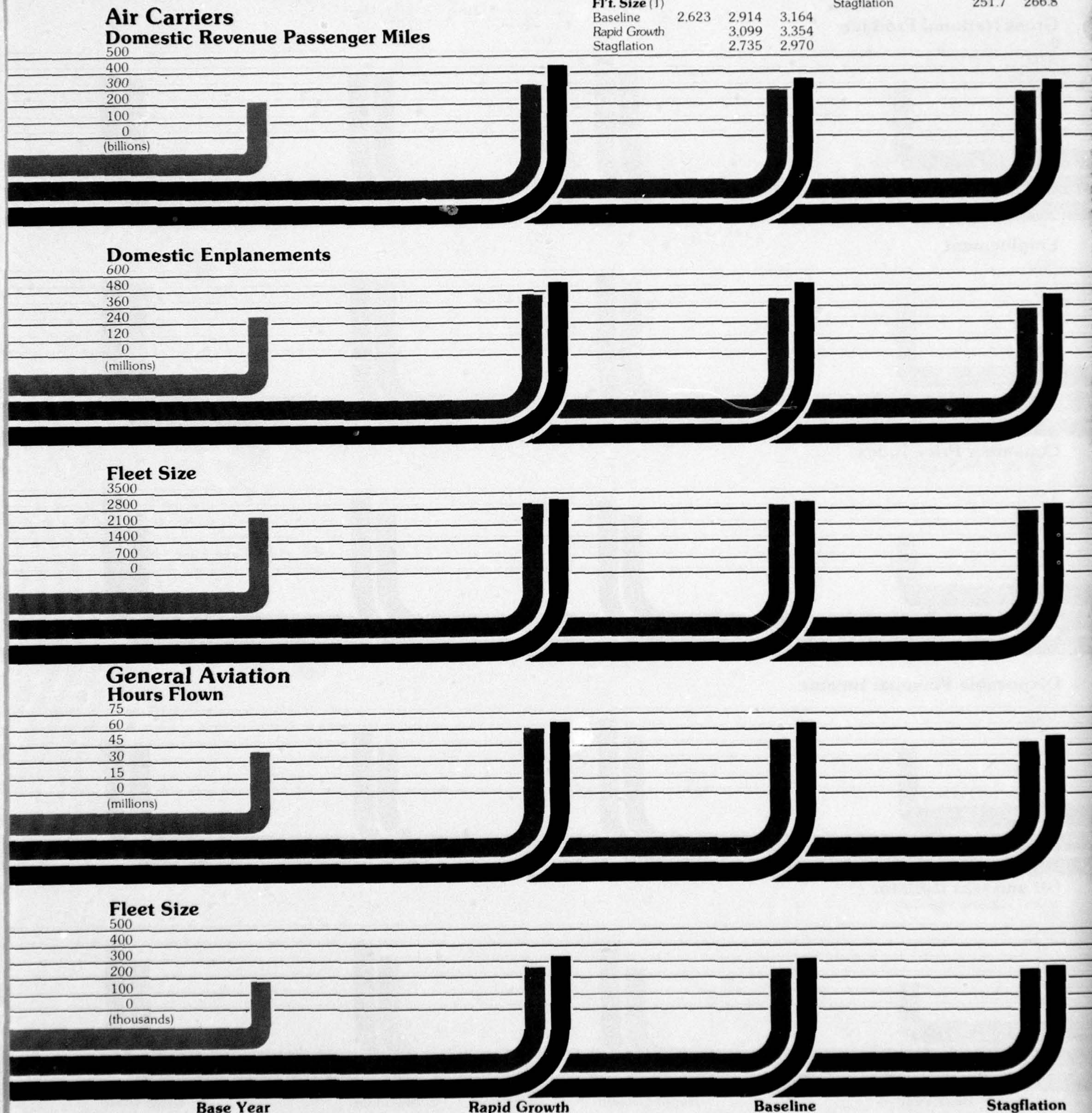
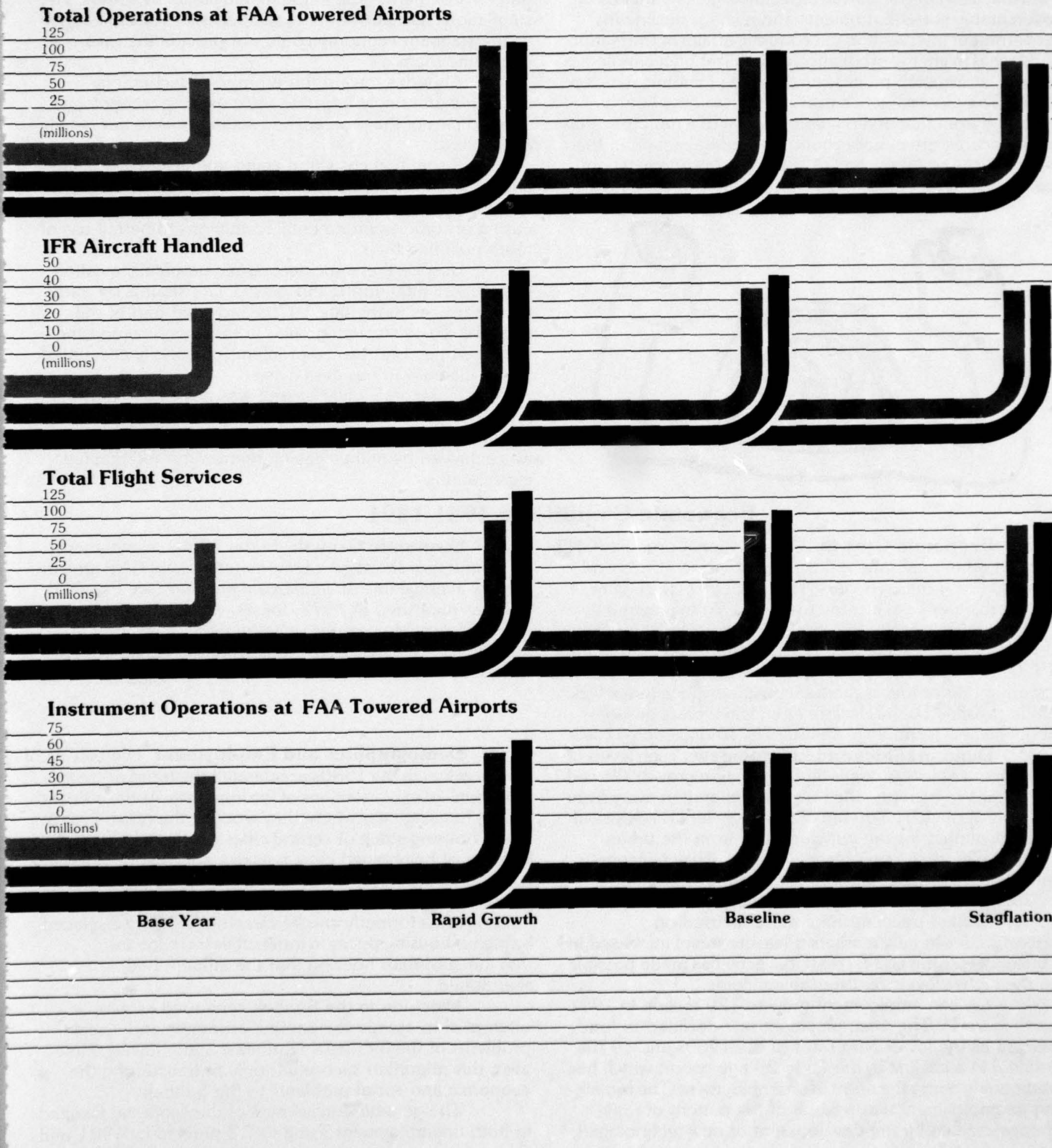


Figure 3.
A Comparison of FAA Workload Measures

1979
1986
1991

Tot. Ops. (M)	1979	1986	1991	Total FS (M)	1979	1986	1991
Baseline	70.6	91.4	100.2	Baseline	68.1	94.5	106.6
Rapid Growth		118.2	122.3	Rapid Growth		98.2	133.1
Stagflation		83.1	78.0	Stagflation		84.8	85.1
Instr. Ops. (M)				**IFR Hndl** (M)			
Baseline	34.8	49.2	55.0	Baseline	29.2	38.7	44.0
Rapid Growth		58.1	67.7	Rapid Growth		39.8	49.7
Stagflation		45.8	52.8	Stagflation		36.2	38.9

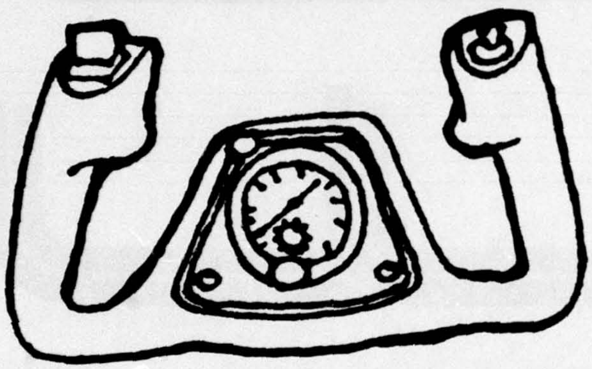


Rapid Growth Scenario

Stagflation Society Scenario

Summary Overview

The most important events of the 1980s were a rejustification of the power of technology as a means of overcoming societal problems and a sharp decline in government intervention in economic affairs of the Nation. Advances in energy production and utilization technologies and in information processing spurred economic development. The Government's role in the economy largely changed from that of a regulator to that of a monitor. Antitrust became the major ground for Federal action in the work places of Americans. All segments of the aviation community prospered as a result of these developments.



Conflicts in the economic, energy price and supply, and environmental arena dominated life in the 1980s. The stagflation crises surrounding all three issues became worse as the stagnant economy could not provide the means to overcome them.

Attitudes toward the promise of technology became increasingly negative since existing technology seemed part of the problem and solutions were not readily available.

Rising fuel costs and aging manufacturing plants contributed to continued high inflation and slow real growth of the economy. Pressure to reduce immediate costs led to easing of some environmental restrictions to permit use of more polluting fuels.

Despite these socioeconomic problems, aviation use grew slightly during this period. Constraints on automobile use, as in the late 1970s, provided part of the increase. The slow, real growth in the economy and the increased need to resolve problems personally accounted for an increase in business flying.

In general, while growth was not dynamic during this period, the material condition of most Americans did not get worse. Accommodation to the surrounding crises was achieved by many, leaving them with more limited expectations.

Economic Conditions: 1981-1991

Economic Growth. Gross national product (GNP) grew at an annual rate of 4.6 percent in the 1980s and climbed to 2.4 trillion dollars (1972) in 1991 (see Figure 1). Disposable personal income rose to $1.70 trillion and on a per capita basis to $6,462 in 1972 dollars. Inflation came down from the double digit rates often experienced in the 1970s to a reasonably stable 4.5 percent in 1991. This lowering rate of the rise in the consumer price index was made possible by the decline in effective costs brought about by new technology and stability among energy costs.

Demographics and Employment. High levels of affluence, stable fuel prices and population growth allowed Americans to continue their outward migration away from the central cities. The dream of the single family house with land accounted for the outward push from the urban centers. Commuting problems declined. New telecommunications systems lowered the need for frequent personal contacts in established business relationships. As a result, business travel became more focused on opportunities in new markets. Pleasure travel increased in pursuit of cultural and recreational activities made possible by the higher levels of disposable income.

Civilian employment grew to 120 million in 1991 (see Figure 1). The unemployment rate declined to four percent as the lower birth rates of the 1960s and 1970s resulted in a decline in the 15 to 29 age cohort which has traditionaly borne the brunt of unemployment. The remaining unemployment was a result of the pattern of rapid change created by the development of new technologies.

Economic Growth. In the 1980s, rising energy prices and spot shortages of raw materials kept GNP growth at a low average rate of 2.4 percent per year (see Figure 1). GNP, as measured in 1972 dollars, was $1.9 trillion in 1991. Disposable personal income (DPI), measured in 1972 dollars, reached $1.21 trillion and per capita DPI grew to $5,592.

Demographics and Employment. High levels of energy prices in the 1980s accelerated the trend of "regentrification" of major sections of the inner city. As the affluent sought housing near where they worked, the rehabilitation of the housing stock of central cities continued. However, because of heightened class tensions and poor economic conditions, the return of the affluent to the central city produced an affluent city core ringed by low income housing in the formerly middle-class fringe. Those displaced by higher housing prices in inner cities were forced into the suburban housing that the affluent had abandoned.

Migration to the Sunbelt continued as people attempted to escape the energy, economic and social problems of the industrial Northeast and Midwest. However, this migration succeeded only in transferring the economic and social problems to the Sunbelt.

The general sluggishness of the economy resulted in both unemployment rising to 7.2 percent by 1991 and

Rapid Growth Scenario

Environment. Rapid economic growth made possible a lower level of conflict between environmental and economic interests. For the most part, concern for the future condition of the environment became institutionalized in the 1980s, in part because it was affordable and because improved knowledge made the consequences of inaction more obvious.

Regulation. The underlying direction of both Federal and state regulatory policy increasingly was a loosening of constraints to encourage private decision-making whenever possible. For example, economic regulation of civil aviation was allowed to cease as provided in the Airline Deregulation Act of 1978 and never resumed. Moreover, even indirect regulation through terms and conditions of subsidies became practically nonexistent as subsidies became less and less necessary. Eventually, other governments saw the wisdom of the U.S. deregulation policy and international aviation was headed toward a complete "open-skies" environment in the early 1990s. The success of airline deregulation was followed by deregulation of the telecommunications, trucking, railroad, and pipeline industries. In one area, however—antitrust—Federal regulation became tougher. For example, the computer industry was forced to comply with divestiture and industry restructuring orders. In environmental and safety regulation, the swift rate of technological advances made possible the achievement of the goals established in the 1970s.

Stagflation Society Scenario

the underlying inflation rate increasing to 7.1 percent. Civilian employment rose to only 107 million by 1991, due to both the stagnant economy and a slowdown in population growth.

As the members of the post-World War II baby boom grew older and general population growth approached the zero growth level, the size of the labor force began leveling off. Labor force participation rates during the period did not change much from what they had been in the 1970s, mostly due to the lack of job opportunities. As the job market became tight and economic growth slowed, fewer men left the labor force at early ages and more women remained at home. This halted the trend of decreasing participation rates for men and increasing rates for women which had prevailed in the 1960s and 1970s.

Environment. The quality of the environment suffered a number of setbacks during the past decade. Improvements in technology did not occur as a result of the lack of capital. Some regression to use of polluting fuels and aging equipment meant that water and air pollution increased again. But, the urban environment was aided somewhat by "regentrification" and the development of exurbia into bedroom communities was slowed. Both of these developments were created by the high cost of fuel and the uncertainty of supplies.

Regulation. The stagnant economy and worsening outlook were the forces behind an end to the drive for deregulation of major industries which had emerged in the late 1970s. The regulatory agencies, at best, provided "quick fix" solutions in response to the petitions of consumer groups; they never established effective, long-term policies for the industries they regulated. The result was partial monopoly power in key industries that kept prices high and stifled technological innovation.

Two major economic regulatory laws were passed. The Airline Deregulation Act of 1978 was amended in response to political pressures from Congressmen representing small and non-hub communities. The Federal Government reassumed power over tariffs and route entry and abandonment. After long debate, a new communications act was passed. However, strict interpretation of the Act by the regulatory agencies and a lack of available capital for new entrants in intercity markets, greatly restricted competition. Interest in deregulation of the railroad, trucking, and pipeline industries quickly faded in the 1980s and remained dormant for the rest of the period.

The United States did not abandon the environmental and safety regulation agenda of the 1970s. However, deadlines for meeting legislatively established environmental and safety goals such as air pollution levels were continually extended in a futile attempt to hold down inflation and improve productivity.

Aviation Activity Forecasts

U.S. Air Carrier and Commuter Activity

Rapid Growth 1986	Rapid Growth 1991		Stagflation 1986	Stagflation 1991
308.4	426.1	Domestic Revenue Passenger Miles (billions)[1]	276.1	336.2
452.3	550.4	Domestic Revenue Passenger Enplanements (millions)[1]	350.8	458.0
12.8	14.0	Air Carrier Operations[2] (millions)	11.5	12.3
8.3	12.9	Air Taxi Operations[2] (millions)	6.5	7.8

[1] In scheduled service of U.S. certificated route Air Carriers including intra-state carriers
[2] At airports with FAA Air Traffic Control Service.

Rapid Growth Scenario

The rapid growth experienced by the trunk, local service and commuter air carriers between 1980 and 1991 resulted from a number of factors. First, although businesses had more and more sophisticated communications services available at decreasing prices, especially from the value-added and specialized common carriers, these services actually stimulated intercity travel instead of substituting for it, as had been expected in the 1960s and 1970s. Thus, businessmen were made even more aware of the opportunities in other countries and regions of the United States.

People who increased their use of air travel in the energy crisis of the late 1970s and early 1980s still preferred air travel for non-local travel even though by late 1984 gasoline and other essential automobile services were again freely available at reasonable prices. The airlines steadily increased their share of the intercity pleasure travel market by continuing deep fare discounts. In fact, 85 percent of their passengers were traveling at discounted fares at the start of the 1990s. The easing fuel situation and fleet modernization enabled them to offer such a large percentage of discounted seats. Finally, international travel increasingly contributed to the success of air carriers in the period. Foreigners found the United States a vacation travel bargain, as inflation rates moderated faster here than elsewhere in the world. By 1990, annual foreign arrivals on U.S. flag carriers reached 7.0 million compared to 3.2 million in 1978. Also, with Government regulatory restrictions easing, U.S. air carriers offered more and more international service and increased their share of world air passengers.

Toward the end of the decade, the annual growth in revenue passenger miles and enplanements experienced by trunk and local service carriers declined somewhat. Airlines greatly increased their profits by accelerating substitution of wide-body and post-1980 narrow-body aircraft for older jets. The new aircraft were more profitable on any given route because of their higher seating capacities and more fuel efficient engines. Also, because Government restrictions on route abandonment ended, the carriers turned over many short-haul routes to commuter airlines and flew the new aircraft on more profitable longer stage lengths.

A larger international travel market resulted from world-wide economic growth and eased Government restrictions on passenger travel. The international market

Stagflation Society Scenario

The airlines were forced to sharply reduce the numbers of discounted seats they offered in order to keep up with inflation; this sharply reduced growth in pleasure travel. Moreover, the impact of the near-end to discounting was magnified by the need of people to spend virtually all of their income for shelter, food, utilities and taxes. Also, the airlines were forced to curb their fleet modernization programs, which they had hoped in the late 1970s would help them adjust to the energy price and supply crises. However, the substitution of air for auto travel somewhat offset these negative forces, as tight gasoline supplies and high prices made intercity automobile travel much more difficult.

Although expansion of international service had, in the 1970s, appeared to offer significant new opportunities, the continuing world-wide inflation turned this into a false hope. The high cost of fuel in foreign lands, which were even more dependent on oil imported from the cartel countries than the United States, and preferential treatment of foreign, state-owned airlines resulted in a most difficult competitive environment for U.S. flag carriers. By the end of the decade, U.S. carriers had lost approximately a third of their international market share.

Fuel rationing, produced by the increasing demand for regulations and necessitated by reductions in imports caused by conflicts in the oil producing nations, both hurt and helped air carriers. It hurt them because they were limited to their 1978 consumption. Therefore, they had to reduce schedules and abandon some routes, usually those at the fringes of their route networks where they had inaugurated service since deregulation. However, the domestic load-factor on the remaining flights hovered around 75 percent because people increasingly substituted air for automobile travel.

Commuter airlines did not do the volume of business that had been expected in the late 1970s. Lacking long-term fuel supply contracts, they had to raise fares continually to pass along increased fuel costs and more often cancelled flights when their fuel allocations were arbitrarily reduced. They also received inadequate Federal assistance, since aircraft loan guarantees and subsidies for essential air service were held at artificially low levels for the sake of economy and encouraging air carriers not to

Rapid Growth Scenario

share of the American carriers increased because they adjusted faster to a competitive international aviation arena than did foreign flag carriers.

The sharp growth of commuter airline activity was initially fostered by trunk carrier abandonment of short-haul markets and Federal subsidies. Growth in the latter part of the decade resulted from expansion of services in existing markets and through the introduction of new, reasonably-priced, 30-50 seat aircraft specifically designed for the commuters' short-haul markets.

Stagflation Society Scenario

abandon even more service at small and non-hubs.

The one bright spot in an otherwise gloomy outlook for commuters at mid-decade was that upper and middle income motorists more and more were taking the plane and leaving their cars at home. But, continually rising fuel costs and lack of capital for improved aircraft eventually extracted their toll from the commuter carriers. The number of carriers declined in the latter half of the 1980s.

General Aviation Activity

Rapid Growth 1986	Rapid Growth 1991		Stagflation 1986	Stagflation 1991
40.7	47.8	General Aviation Itinerant Operations (millions)[1]	35.4	32.6
34.1	45.1	General Aviation Local Operations (millions)[1]	26.5	22.8
58.1	67.7	Total Instrument Operations (millions)[1]	45.8	52.8

[1] At airports with FAA Air Traffic Control Service

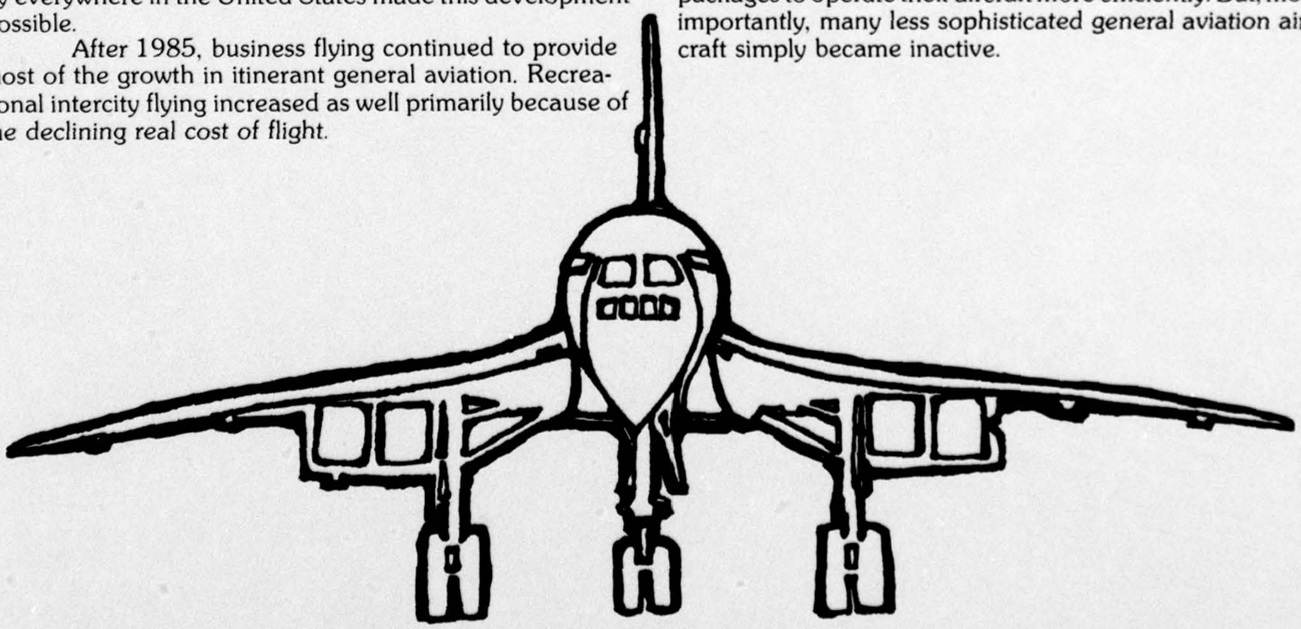
Business flying primarily caused the sharp increase in itinerant general aviation activity between 1980 and 1986. Industrial dispersal to previously remote areas, especially in the Sunbelt, along with inability of commuters to keep up with demand caused the increase. Personal and recreational flying grew at an increasing rate as real fuel costs moderated throughout the period.

Seventy-five percent of the active general aviation fleet was equipped for flight under instrument flight rules by 1984 compared to 51 percent in 1976. Declining real cost of avionics and the desire of more private pilots to be able to fly everywhere in the United States made this development possible.

After 1985, business flying continued to provide most of the growth in itinerant general aviation. Recreational intercity flying increased as well primarily because of the declining real cost of flight.

The fuel crisis made the position of general aviation even more acute in the late than it had been in the early 1980s. Not only were general aviation fuel prices high and rising, but the limited availability and high price of gasoline for automobiles restricted access of private pilots to their planes and the rationing program limited nonagricultural general aviation to its 1978 fuel consumption.

Seventy-five percent of the active aircraft fleet was equipped for flight under instrument flight rules by the end of the period. This was due, in part, to the declining real cost of avionics. Aircraft owners employed various avionics packages to operate their aircraft more efficiently. But, more importantly, many less sophisticated general aviation aircraft simply became inactive.



Rapid Growth Scenario

Implications

Extreme airport airside and landside congestion developed by the mid-1980s. The severity of the crisis caused increasing demand for additional construction—both expansion of existing airports and construction of new ones. Although some new construction programs were undertaken, long lead times prevented a major impact from occurring.

Installation of the upgraded third generation air traffic control system at large hub airports coupled with rapid introduction of wide-bodied aircraft ended airside saturation of those airports by 1990. Thus, by 1991, the measures—such as auctions, variable landing fees and quotas—these airports had introduced to distribute scarce landing and takeoff slots had disappeared. However, even in 1991, ground access and terminal building capacity continued to be strained at these airports. In the absence of new capacity, airlines and airport authorities coped with the problem with a variety of measures such as: adding new flights only at satellite airports, offering free limousine service from central business districts, limiting parking availability, and even barring greeters and well-wishers from terminal buildings.

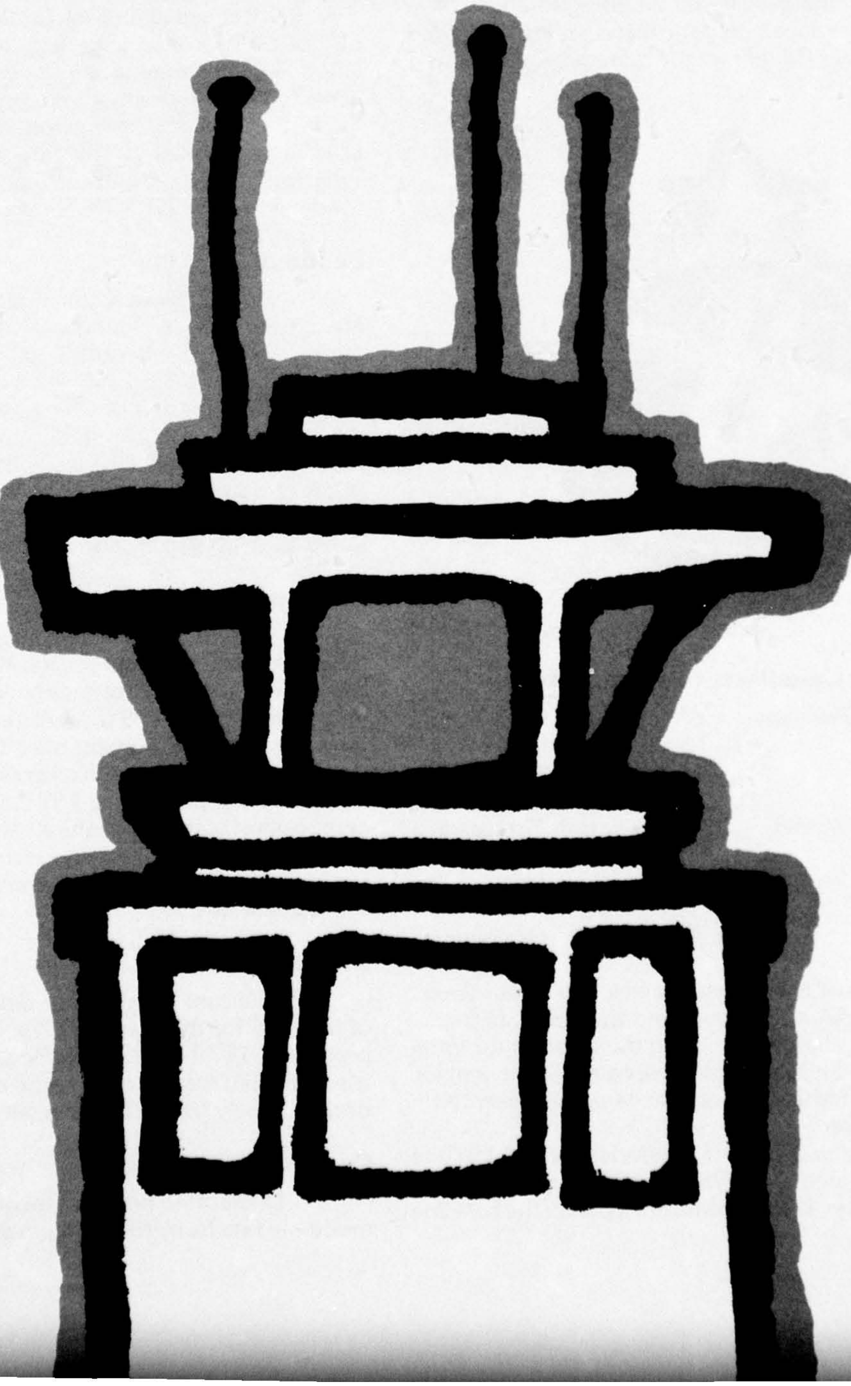
General aviation pilots continued to confront the problem of airport closures because alternative uses of land occupied by small privately owned airports brought higher rates of return. However, fixed base operators became aware of increasing demand for airport services and opened more airports in exurbia than were closed in suburbia.

Stagflation Society Scenario

The airport airside and landside capacity crises that had been feared in the late 1970s only partly materialized. More and more air travelers used city or airport-operated mass transit for the ground portions of their trips as they had to conserve gasoline for commuting and emergencies. However, the stock of major airport terminal facilities proved to be very inadequate at peak travel hours because the number of enplaned passengers grew five times faster than the number of flights.

The air traffic control system of the 1970s, proved to be more than adequate for the early 1980s since growth in operations leveled off. Thus, although FAA continued developmental work on advanced air traffic control systems, both FAA and the user community could not see a need for near-term implementation. As old air traffic control equipment wore out, FAA replaced it with advanced systems which did not require new avionics sophistication. This policy provided sufficient terminal airside capacity at most large and medium hub air carrier airports. There was also adequate runway and taxiway capacity at those airports for the existing schedules. Thus, the highest priorities for Airport and Airway Trust funds were adding to airport terminals to permit accommodation of peak loads and replacing worn out airside facilities at large and medium hub airports to let them accommodate newer air carrier aircraft.

Chapter 3: 1979 FAA Aviation Forecasts



The 1979 National aviation forecast presented in this chapter follows essentially the same methodology and format employed in previous years. Forecast output focuses on two major categories: aviation user activity and Federal Aviation Administration (FAA) operational services.

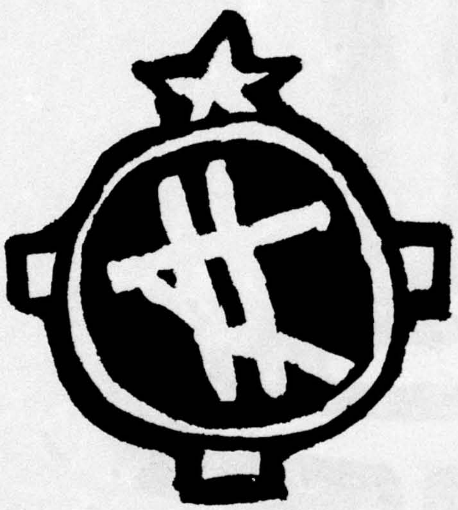
Aviation Activity

- General aviation
- Air carrier
- Air taxi and commuter airlines
- Military aviation

FAA Operational Services

- Total aircraft operations
- Instrument operations
- IFR aircraft handled
- Flight services

Data for five years are provided here: 1974 historical, 1979 estimated status, and 1981, 1986, 1991 forecast for each variable. The methodologies and assumptions used in developing the forecasts are explained briefly. These are explained more fully in the sources listed below.



Sources for Constituent Forecast Models

General Aviation Forecast Model	*FAA Aviation Forecasts Fiscal Years 1978-1989,* FAA-AVP-77-32, September, 1977
Macro Air Carrier Model	*FAA Aviation Forecasts Fiscal Years 1979-1990,* FAA-AVP-78-11, September, 1978
Air Cargo Model	Appendix C, this volume

This forecast is the baseline aviation forecast—a requirement for FAA operational and budget planning. Other users, particularly those using the forecast for long-term capital expenditure planning, are cautioned to employ it within the context of the alternative scenarios presented in the previous chapter.

Annual data covering the historical period 1970 to 1978, 1979 estimated and 1980 to 1991 forecast are presented in Chapter 4. These data are a part of the baseline forecast.

Baseline Forecast: Socioeconomic Assumptions

Considerable uncertainty surrounds predictions made for economic growth over both the short-term and the long-term. World affairs, especially in the case of fuel prices, and domestic affairs are undergoing a period of rapid change which contributes significantly to this uncertainty. Strong pressures exist for lowered government spending and for reduction of governmental intervention in the marketplace. These varying forces may create large short-term fluctuations in the National growth rate in the near future. However, accommodation to these forces is expected to occur, resulting in more steady and sustainable growth over the 12 year forecast period.

The overall outlook for the forecast period consists of moderate economic growth, declining unemployment, and a slow abatement in inflation. Growth rates are expected to be more moderate than have been observed in the last ten years. The economic assumptions which are used in preparation of this forecast were derived from the Wharton Long-Term Industry and Economic Forecasting Model issued in June 1979 (see Figure 4).

Economic Growth

Annual gross national product (GNP) growth rates are expected to vary between 1.4 percent and 3.5 percent during the forecast period. Total growth in fiscal year 1979 is estimated to be 1.9 percent over the level obtained in 1978. After a period of slow growth in 1979 and 1980, growth rates are anticipated to average approximately 3.0 percent over the next 10 years. Higher fuel costs, lowered levels of population growth and assumed smaller increments in productivity improvements justify the lowered forecast of GNP growth in comparison to historical trends.

Employment

Growth in employment has exceeded historical trends over the past few years with women coming into the labor force in significant numbers. The number of individuals employed in 1979 is predicted to rise to 96.0 million, a growth rate of 3.8 percent over 1978 according to the Wharton forecast. In future years this growth rate will decline to 1.1 percent by 1991. Changes in the age composition of the population—with relatively fewer young people in the labor market—accounts for this decline. For similar reasons, the unemployment rate should decline to 4.7 percent in 1991.

Inflation

The consumer price index is taken as the indicator of inflation for this forecast. The index increased 10.2 percent in 1979 over 1978. Beginning in 1980, it is assumed that the increase in the consumer price index will decline slowly from 10.2 percent to 5.0 percent.

Consumer Spending

Disposable personal income will increase at a moderate rate from 987.4 billion dollars in 1979 to 1,342.4

billion dollars in 1991. Consumption patterns will continue to shift as fuel takes a higher percentage of disposable income and more fuel-efficient durable goods are purchased. Personal consumption of services will not increase as rapidly as GNP. Consequently, the utilization of aviation services will weaken somewhat from historical trends but still grow at a faster rate than the GNP.

Fuel

Fuel prices, based on the Wharton projection of the oil and gas deflator, will increase more than 184 percent by 1991. This projection does not include increases imposed by any additional domestic taxes on aviation fuel. Furthermore, the baseline forecast does not assume any fuel usage constraints other than increasing fuel prices.

Regulatory Change

Implementation of the Airline Deregulation Act of 1978 already has resulted in significant changes in air carrier activity. The baseline forecast includes the assumption that tnis Act will substantially control air carrier market entry and exit behavior for the duration of the forecast period. Additionally, the encouragement offered through the Act to the commuter airlines is assumed to be accepted with a resulting increase in commuter activity.

Figure 4.
Economic Assumptions Underlying Baseline Fiscal Year 1979–1991 Aviation Forecasts

	Employment	Gross National Product	Disposable Personal Income	Consumer Price Index	Oil & Gas Deflator
1979	96.0	1,423.4	987.4	210.6	209.9
1981	99.4	1,482.9	1,022.5	251.4	293.0
1986	107.0	1,725.6	1,171.2	343.0	453.8
1991	113.6	1,978.6	1,342.4	445.9	597.0

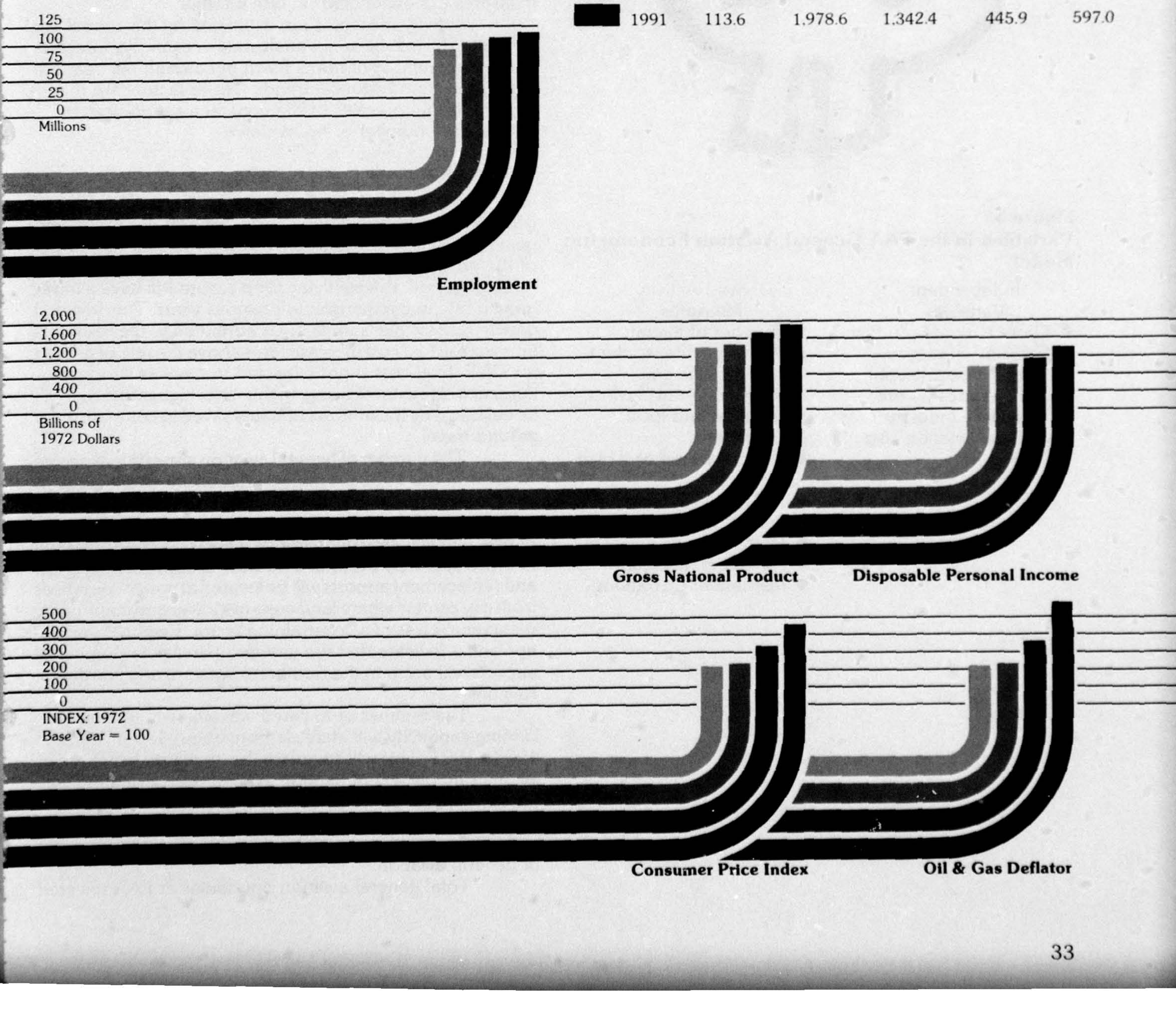


Figure 5.
Variables in the FAA General Aviation Econometric Model

Independent Variables
- Gross national product.
- Civilians employed.
- Plant and equipment expenditures by the aerospace industry.
- *General aviation cost index.*

Derived Activity Measures
- Number of aircraft.
- Active private, student, commercial, and instrument-rated pilots.
- Itinerant and local operations.
- IFR departures and over flights.
- IFR and VFR flight plans filed.
- Pilot briefs.
- Aircraft contacted.
- Instrument operations.

Aviation Activity Forecasts

General Aviation

Methodology and Assumptions

The methodology and assumptions employed in forecasting general aviation activity have been augmented to incorporate the effects of aviation significant events through trend and cross impact analysis since 1978. The basic forecasts of general aviation activity are derived from the FAA's General Aviation Forecast Model, an econometric model that relates measures of aviation activity to economic and demographic variables. The independent exogenous variables, which come primarily from the Wharton Econometric Forecasting Associates Annual Model, and the measures of aviation activity used in the General Aviation Forecast Model are summarized in Figure 5. The fundamental assumptions underlying this approach are that the various measures of aviation activity are related to the level of economic activity and that the various activity measures are dependent on one another.

Activity measures not estimated by this model are generated from time-series analyses. For example, forecasts of average number of hours flown per aircraft per year are developed from historical trends. These factors are then applied to the forecasts of the general aviation fleet to estimate the number of hours flown.

General Forecast

Business flying is becoming an increasing share of general aviation activity. It is expected that corporate and general business flying will provide a significant proportion of the growth anticipated for general aviation over the forecast period. Private flying for pleasure will have a lower growth rate in comparison to previous years. This lowered growth rate for pleasure flying is attributed to the restraints imposed by fuel cost increase rates above the rate of growth for GNP. Fuel cost is not expected to nave as strong an influence on business flying. In this case, higher fuel cost will be balanced by the number of hours saved in comparison to ground travel.

The number of general aviation airports is expected to grow in the 1980s. Traffic limitations at major hub air- will increase the use of reliever airports with some training and pleasure flying activities responding to the convenience of new and less crowded airports. Diversion of airport land to other uses may occur in a number of communities. New and replacement airports will be located at greater distances from city centers where land costs are lower and community resistance is less of a constraining factor. Regional population shifts indicate that the greatest increase in number of airports will occur in the Southern, Western and Northwest Regions.

The number of towered airports with instrument landing capability will increase from about 430 in 1979 to 490 in 1991. This will stimulate the increased purchase of avionics by owners of general aviation aircraft and make possible increased traffic volumes at the affected airports. Greater avionics use and its associated higher education and training requirements should reduce the accident rates of general aviation.

Total general aviation operations at FAA towered

airports are estimated at 53.4 million in 1979, a 5.1 percent increase over 1978. Reflecting greater aviation use by corporations, general aviation itinerant operations will grow from 30.0 million in 1979 to 43.2 million in 1991. Local general aviation operations will increase from 23.4 million to 32.6 million between 1979 and 1991.

Fleet Size

Status: The general aviation fleet continues to grow. As of January 1, 1979 there were 193,000 active aircraft in personal and business use, an increase of 4.7 percent over 1978. The distribution of this fleet across the FAA regions is shown in Figure 6.

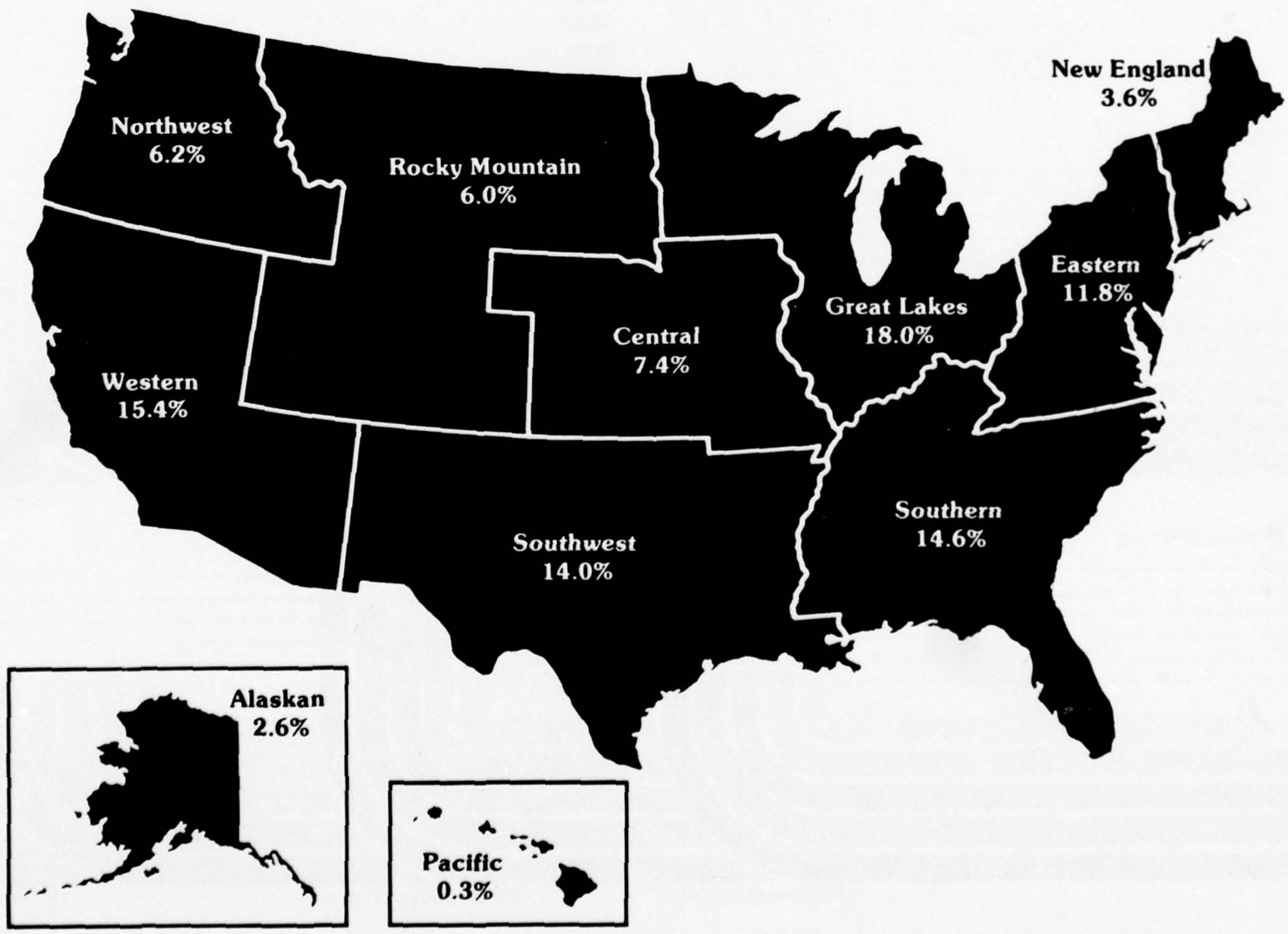
Forecast: Production of new general aviation aircraft will continue during the forecast period with an annual growth rate of approximately 3.9 percent. This rate is 0.8 percent less than that experienced from 1974 to 1979. Fleet growth is expected to be accompanied by increasing sophistication in avionics. Avionics equipment will become more generally available for single engine aircraft,the largest segment of the general aviation fleet (see Figure 7).

Fleet Composition

Status: Single engine piston aircraft account for 80.4 percent of the general aviation fleet (155,200 as of January 1, 1979). The remaining 19.6 percent is distributed among multiengine piston aircraft (23,000), turbine aircraft (5,900), rotorcraft (5,100), and balloons, dirigibles and gliders (3,800).

Forecast: While the overall composition of the fleet will not change much over the next 12 years, a slightly faster growth rate is expected for the larger, more sophisticated aircraft. In 1991, multiengine piston aircraft will account for 12.5 percent of the fleet against 11.9 percent in 1979. Single engine piston aircraft will constitute 77.8 percent in 1991. A greater percentage of corporate ownership and increasing general aviation pilot sophistication are the major contributors to this expected change in fleet composition.

Figure 6.
Distribution of General Aviation Aircraft by FAA Region, January 1, 1979



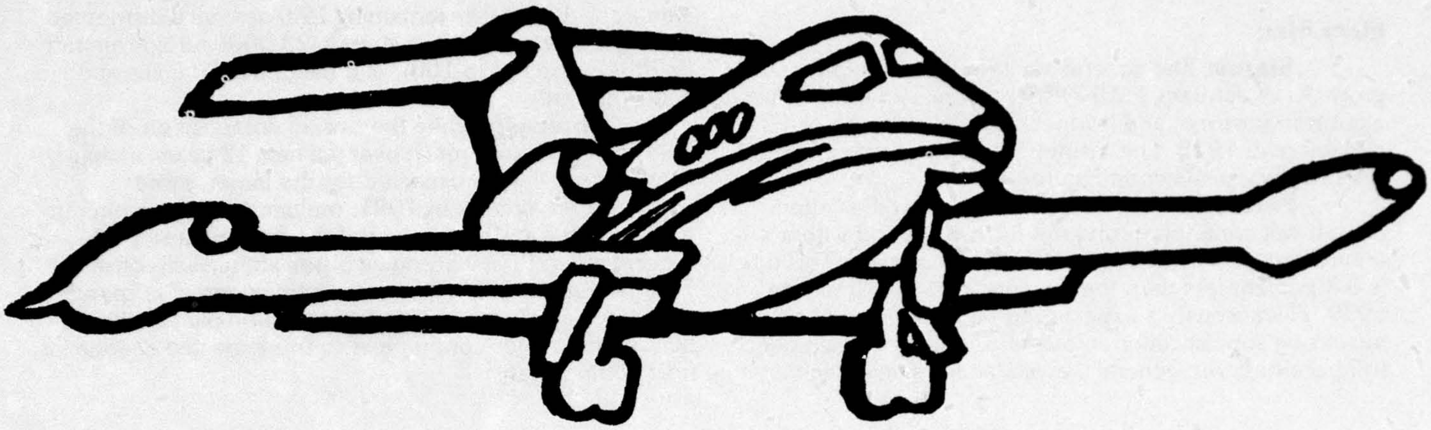
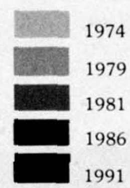
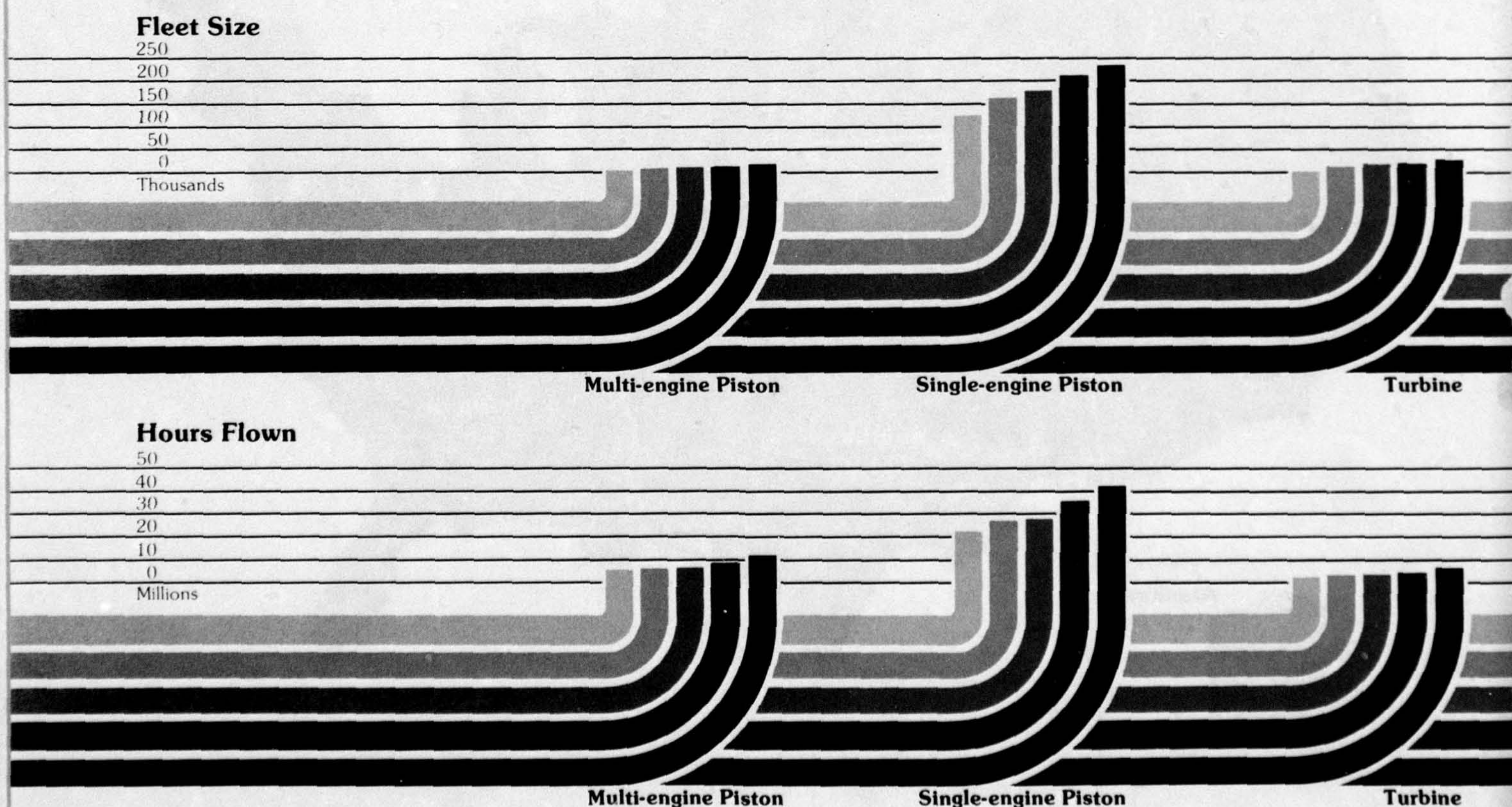


Figure 7.
General Aviation Fleet Size and Hours Flown



	FY 1979 Status (Growth)	FY 1979-91 Forecast Average Annual Growth Rate
Fleet	+4.7%	+3.9%
Hours	+5.1%	+4.2%



Hours Flown

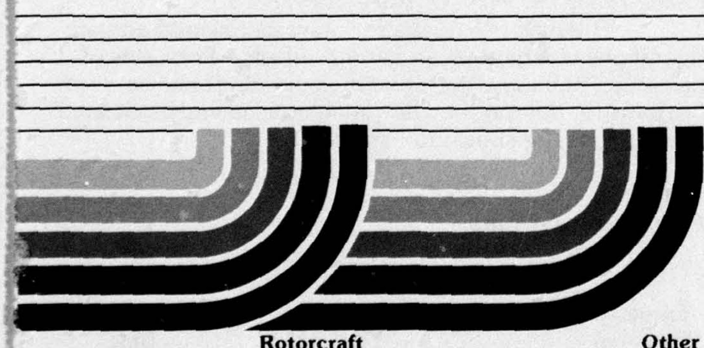
Status: Preliminary estimates indicate that hours flown by general aviation aircraft have reached 39.0 million hours in 1979 in comparison to 37.1 million hours in 1978. This growth of 5.1 percent occurred despite the continuing increases in fuel costs.

Forecast: The number of hours flown is forecast to increase to 64.0 million by 1991, which is 64.1 percent higher than the 1979 total. As shown in Figure 7, this translates to a 4.2 percent average annual growth rate. The average annual increase was 4.9 percent from 1974 through 1979. The lower growth rate forecast is due primarily to anticipated higher fuel costs for general aviation and is consistent with recent increases in aircraft utilization rates.

Active Pilots

Status: The number of active pilots increased from 783,900 during the year starting January 1, 1978, to 798,800 an increase of 1.9 percent. The number of instrument rated pilots increased at a 4.4 percent rate during the same period of time. As of January 1, 1979 instrument ratings were held by 29.6 percent of all active pilots.

Forecast: The number of active pilots is expected to increase to 1,110,700 by 1991. This represents a 39.0 percent increase during the forecast period. The number of private pilots is forecast to increase as interest in flying grows among a population that will be slightly older, will have fewer children, and will have steadily rising disposable personal income. The number of student pilots is forecast to rise slowly from approximately 204,900 in 1979 to a peak of 226,000 in 1985 and to decline steadily thereafter, going back to 210,000 in 1991. Since the number of pilots who will give up their license are fewer than the number of new pilots trained, the private pilot population will increase steadily during the forecast—rising from 337,600 in 1979 to 500,000 in 1991. Despite the increase in the number of pilots, pleasure flights by individuals are expected to diminish in importance as cost continue to increase and as those urban general aviation airports that continue operations become more crowded.



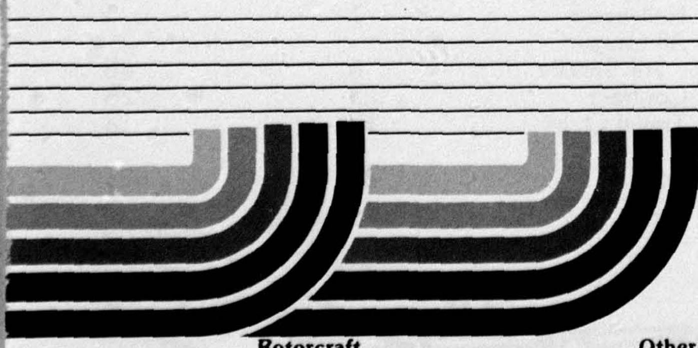
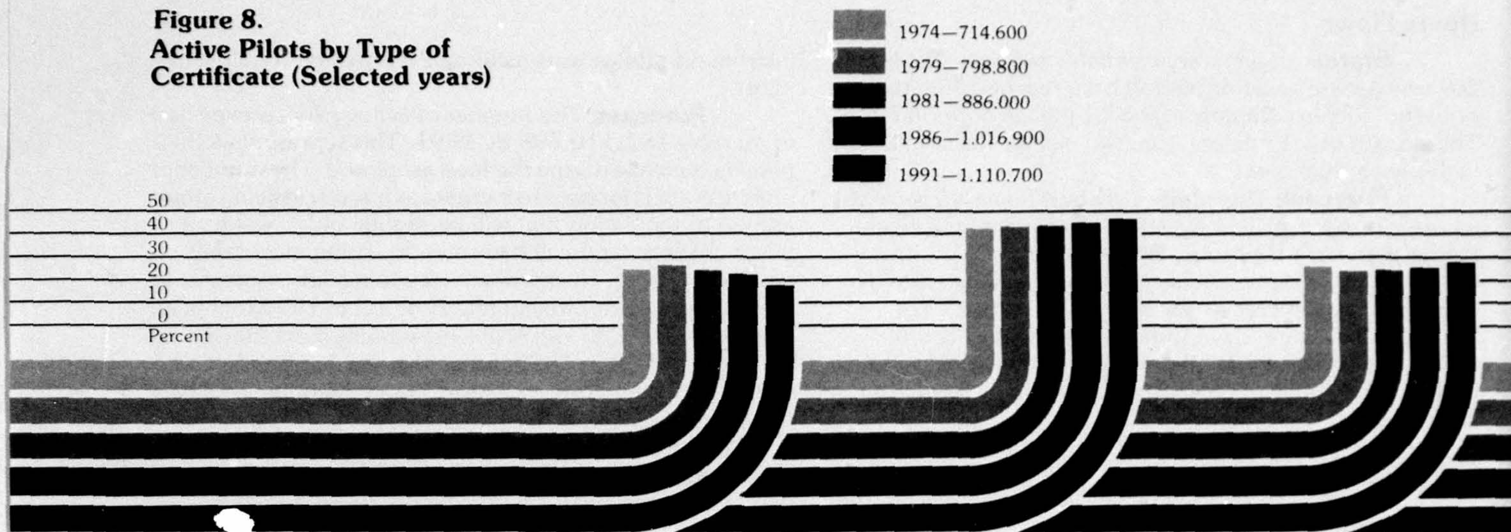


Figure 8.
Active Pilots by Type of Certificate (Selected years)



Air Carriers

The use of the term certificated route air carrier has been modified in response to the Airline Deregulation Act of 1978. Beginning with this forecast, intra-state and supplemental air carrier passenger enplanements on scheduled flights are included in the totals for certificated route air carrier scheduled passenger traffic. Air carrier operations counts have always included all three types of service. This new definition reflects the awarding of inter-state scheduled service authority to the still largely intra-state and supplemental carriers.

The general FAA definition of an air carrier remains: "any operator of large aircraft that transports passengers or cargo for hire." FAA classifications and fleet sizes for the different types of air carrier operators are listed in Figure 9. The operations of these 82 air carriers at FAA towered airports, along with foreign air carriers serving the United States and the air carrier traffic handled by the Air Route Traffic Control Centers (ARTCCs), are the subject of this part of the forecast.

Methodology and Assumptions

Two techniques are employed to forecast the level of air carrier aircraft activity and the anticipated workload at FAA facilities: the macro air carrier forecasting model and the micro method. Outputs from the two methods are compared and adjusted to achieve a consistent forecast.

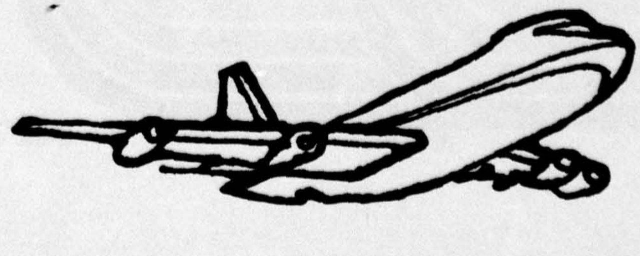
Macro Air Carrier Forecasting Model: Air carrier demand forecasts of revenue passenger miles (RPMs) and enplanements (ENPs) are generated using an econometric forecasting model derived from historical relationships between various measures of economic activity and air carrier demand. The economic variables used in this model are summarized in Figure 10. The forecasts of operating characteristics used in the model (see Figure 11) are based on time series analysis, with adjustments made for changes in costs and fares. For example, when costs increase faster than fares, airline profitability requires an increase in load-factor, seating density, or both. Continuing growth in aircraft size is reflected in the increasing average seating capacity used in the model.

Generally, the macro model shows that demand falls as growth in the general economy decreases and unemployment increases, and that demand rises with personal income or as the cost of owning and operating a car increases. A basic modeling assumption is that historical relationships among these variables will continue in the future. For a more detailed discussion of this model, refer to Appendix B of *Federal Aviation Administration Forecasts Fiscal Years 1979-1990,* FAA-AVP-78-11.

The macro model also forecasts towered aircraft operations for the total air carrier industry. Forecasts of passenger traffic and the industry's operating behavior form the basis for this model. The variables used and associated assumptions are shown in Figure 11.

Figure 9.
Air Carrier Groups

	No. of Carriers	Fleet Size
Trunk	11	1,726
Regional	20	562
All Cargo	3	46
Supplemental	6	74
Helicopter	1	3
All Cargo Air Service	6	66
Contract	25	128
Travel Clubs	10	18
Total	82	2,623



Airline Transport | Helicopter | Glider and Others

Figure 10.
Exogenous Variables Employed in the FAA Macro Air Carrier Forecasting Model

Economic Variable	Function
• Disposable Personal Income	• Indicates the real purchasing power available to be spent on consumer goods
• Unemployment Rate	• Reflects the negative psychological impact of a high unemployment rate
• Consumer Price Index	• Deflator for yeild and price of private transportation
• Deflator for Oil and Gas	• Represents the relative price of oil and gas products and is used to determine yield
• Index of the Wage Rate	• Used along with the price of oil and gas to determine yield

Figure 11.
Variables and Assumptions Used in the FAA Macro Air Carrier Forecasting Model

Variable	Assumption
• Revenue passenger miles	• The economic assumptions indicate RPMs will increase with a rise in disposable income and the cost of owning, operating and maintaining a car. Increases in yield or unemployment have negative effects on RPMs.
• Average passenger load-factor	• Load-factors will fluctuate between 60 and 62 percent through the mid-1980s and then stabilize at 62 percent for the remainder of the forecast period.
• Average seating capacity	• Average seating capacity will increase by about 4 seats per year as air carriers attempt to reduce the cost per seat-mile by purchasing more wide-body aircraft and adding seats to the existing fleet.
• Average stage-length	• Average stage-length will increase by about 3 miles per year.

Micro Air Carrier Forecasting: The micro procedure employs individual forecasts for each carrier in the industry. These are used to forecast fleet size, hours and miles flown, and, in conjunction with the macro model, to forecast operations. The driving variable is the number of aircraft, by type, that each carrier has on hand and on order. Estimates for future types and number are made after discussions with air carriers and with all major domestic aircraft manufacturers. Estimates are made for the additional aircraft orders, beyond those announced publicly, that will be required to meet anticipated traffic growth, provide for retirement of aircraft, and allow each individual airline to maintain a competitive position with other airlines.

Judgement is used in projecting the forecasts beyond the years for which information is available. Service patterns and frequency of service are also forecast in general terms after discussions with members of the industry. The micro variables used and associated assumptions are described in Figure 12.

Figure 12.
Variables and Assumptions Employed in the FAA Micro Air Carrier Forecasts

Variable	Assumptions (Based on Discussions with Industry Members)
• Aircraft Type	
*Two-engine	• Continued introduction of DC-9 and 737. • Introduction of a new standard body and wide-body aircraft in early 1980s.
*Three-engine	• Continued introduction of wide-body aircraft and 727 and 727-200. • Appearance of stretch versions of present wide-body aircraft in the mid-1980s.
*Four-engine	• Continued retirement of nonfan and older fan-jet aircraft. • Continued introduction of present wide-body aircraft.
• Seating Capacity	• Continued decrease in size of the first class section and a concommitant increase in the coach section. • Completion of the one-seat increase in the number of seats abreast in wide-body jets by the end of the 1970s.
• Passenger Load-Factor	• A gradual increase in the load-factor from the present 60 percent to 62 percent by the early 1980s, and then remaining at 62 percent through 1991.

General Forecast

Demand for air transportation will continue to grow at a higher rate than the GNP and disposable personal income. The advantages in time and convenience provided by this sector of transportation are reflected in this faster growth rate. However, rising fuel and other resource costs reflected in higher fares will keep future air transportation growth rates at more moderate levels than have been experienced in the past.

The pattern of air carrier services is expected to change as the result of deregulation. Some smaller cities are losing airline service as those carriers seek to maximize the utilization of their large aircraft. It is assumed that commuter airlines and air taxi operations will replace this service in most of these smaller markets. Continually rising fuel costs and capacity limits at airports will encourage air carriers to accommodate increasing demand by achieving improved load-factors and by employing greater seating capacity within their retained and new markets.

Technological developments in aviation are expected to improve operating economics and fuel efficiency and to reduce noise. A new U.S. built, energy-efficient, two-engine, wide-body airplane should become operational in the early 1980s, and a new two-engine standard body jet should become operational in the early and mid-1980s. Another three-engione wide-body aircraft may become available toward the end of the forecast period. Stretch versions of existing models will be introduced as airlines seek increased capacity from proven configurations. Supersonic flight will not be initiated between domestic points because of environmental concerns and high energy costs.

Revenue Passenger Miles

Status: Widespread use of discount fares accounted for the 15.8 percent growth in domestic revenue passenger miles (RPM) during FY 1979 without adding the contribution of the newly included carriers. International RPMs increased 22.1 percent.

Forecast: Domestic RPMs are forecast to grow from 204.7 billion miles in 1979 to 364.5 billion miles in 1991. The addition of 92.2 billion international RPMs in the year 1991 yields a total of 456.7 billion RPMs for all U.S. carriers, an increase of 78 percent over the 1979 total. The expected restructuring of service markets which has already begun will increase average passenger trip length. As a result, RPMs will grow at a faster rate than passenger enplanements. See Figure 13.

Revenue Passenger Enplanements

Status: Revenue passenger enplanements rose to 317.7 million in 1979 (includes the new carriers). The effects of the strike at United Airlines, the largest domestic carrier, were mitigated by their unusually rapid recovery following the strike and by additional capacity added by other airlines during the strike.

Forecast: International revenue passenger enplanements are expected to continue growing at a slightly faster rate than domestic revenue passenger enplanements, 76.1 percent vs. 69.8 percent between 1979 and 1991.

Air Carrier Fleet

Status: Fleet size increases very slowly on a year-to-year basis. The addition of 128 aircraft to the fleet in 1979 brought total fleet size to 2,623. However, half of this increase has been caused by new all cargo carriers operating smaller aircraft.

Forecast: The fleet will grow only 20.6 percent to 3,164 aircraft during the forecast period. However, average seating capacity will increase to accommodate the higher demand as older airplanes are replaced by newer, larger aircraft.

Commuter Air Carriers

Methodology and Assumptions

A full discussion of the forecasting models used to predict commuter air carrier growth is contained in *Forecast of Commuter Airlines Activity*, FAA-AVP-77-28, July 1977. The models remain essentially unchanged in 1979.

An econometric model was used to generate 12-year National and terminal area forecasts for commuter passenger enplanements, operations, and fleet composition for the 48 contiguous states and Puerto Rico. In addition, those points likely to become candidates for commuter service in future years were identified.

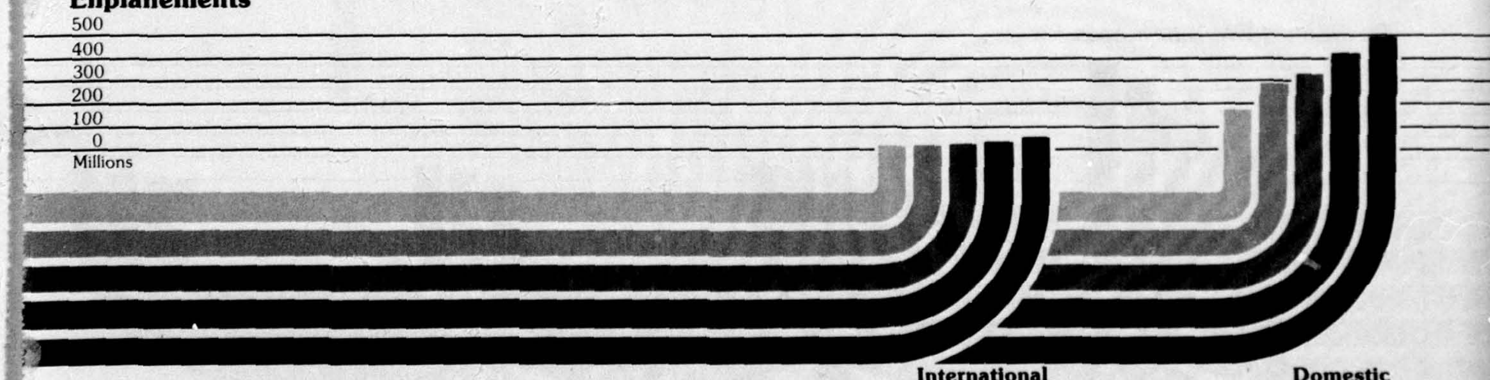
Two sets of National forecasts are provided, one for all points receiving commuter service in 1979 and one for new points that have potential for commuter operations. Enplanements in Puerto Rico are presented as a separate forecast because of the different characteristics of that service.

Figure 13.
Air Carrier Passenger Enplanements and Revenue Passenger Miles, Fiscal Years 1974–1991

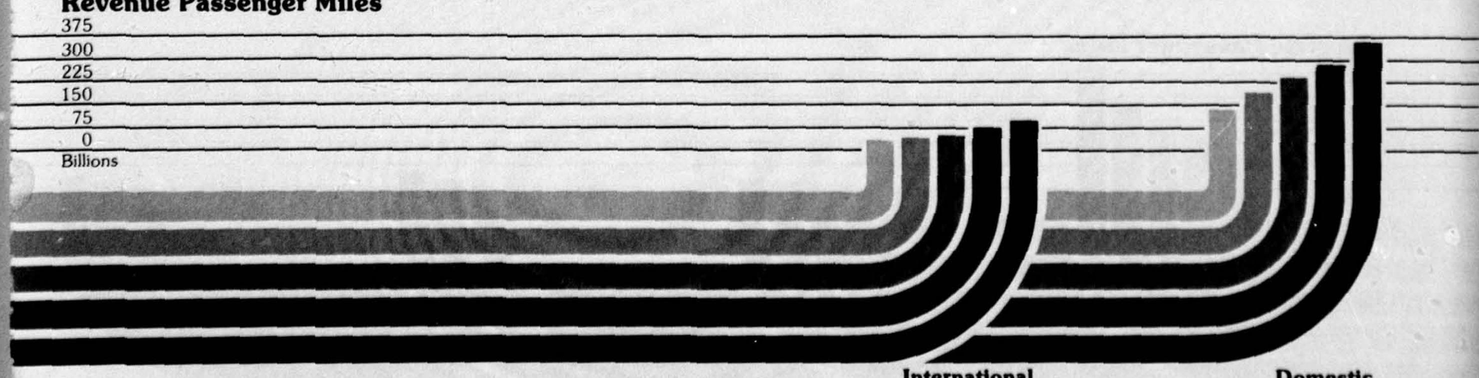
	FY 1979 Status (Growth)	FY 1979-91 Forecast (Total Growth)
Enplanements	+ 19.1%	+ 70.3%
Revenue Passenger Miles	+ 17.0%	+ 78.3%

1974
1979
1981
1986
1991

Enplanements



Revenue Passenger Miles



Revenue Passenger Enplanements

Status: Revenue passenger enplanements have increased steadily over the past five years to a total of 9.9 million in 1979. However, the number of airports served by commuter airlines has only started to rebound from a decrease in 1977 to 764.

Forecast: Enactment of deregulation in 1978 and regulatory change to improve safety are expected to provide new stimulation to the commuter airlines. Total commuter enplanements are expected to more than double between 1979 and 1991 and to reach 20.3 million. Approximately 9.6 percent of this 12 year growth will be generated by new service points while 15.4 percent will result from the eased transfer capability envisioned under deregulation.

Revenue Passenger Miles

Status: For the first time more than a billion revenue passenger miles (1,226,800,000 miles) were flown by commuter airlines in 1979.

Forecasts: The growth rate in revenue passenger miles is expected to decline in relation to the rates obtained in 1974-1979. Commuter revenue passenger miles increased 93.6 percent during the period 1974-1979. During the periods 1981-1986 and 1986-1991 the five year growth increments will decrease from 42.1 percent to 35.1 percent.

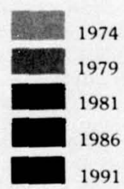
Aircraft Operations

Status: Commuter operations are estimated from reported enplanement figures. The assumption of 6.0 boardings per flight yields an estimated 3.3 million operations at towered and non-towered airports for 1979.

Forecast: A total of 5.6 million commuter operations in the United States and Puerto Rico will be reached in the year 1991. This assumes that the passenger boarding factor will increase to 7.2 by that year.

Figure 14.
Commuter Carrier Passenger Enplanements and Revenue Passenger Miles, Calendar Years 1974–1991

	CY 1979 Status (Growth)	CY 1979-91 Forecast (Total Growth)
Enplanements	+ 12.5%	+ 105.1%
Revenue Passenger Miles	+ 22.4%	+ 108.7%



Passenger Enplanements

Revenue Passenger Miles

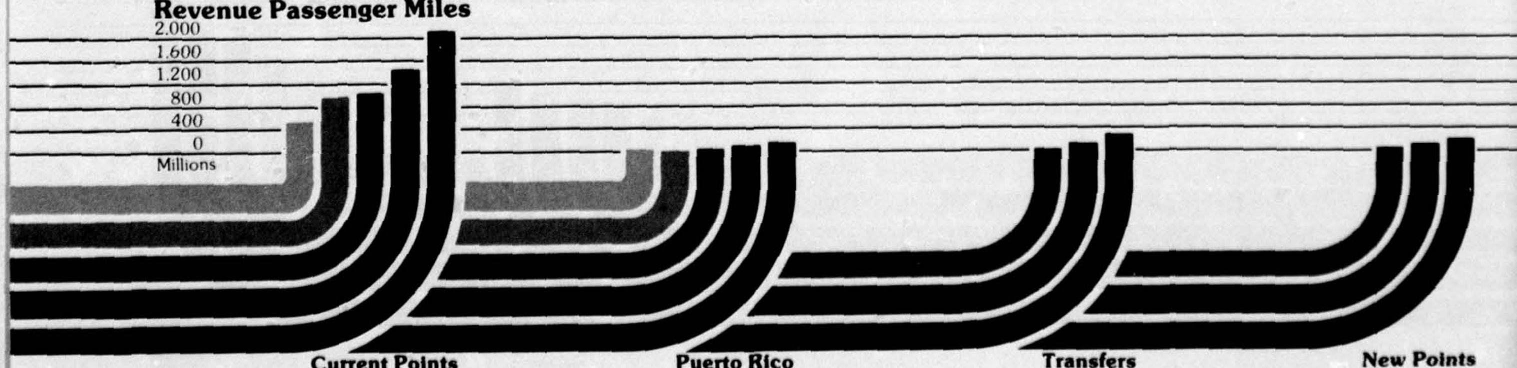
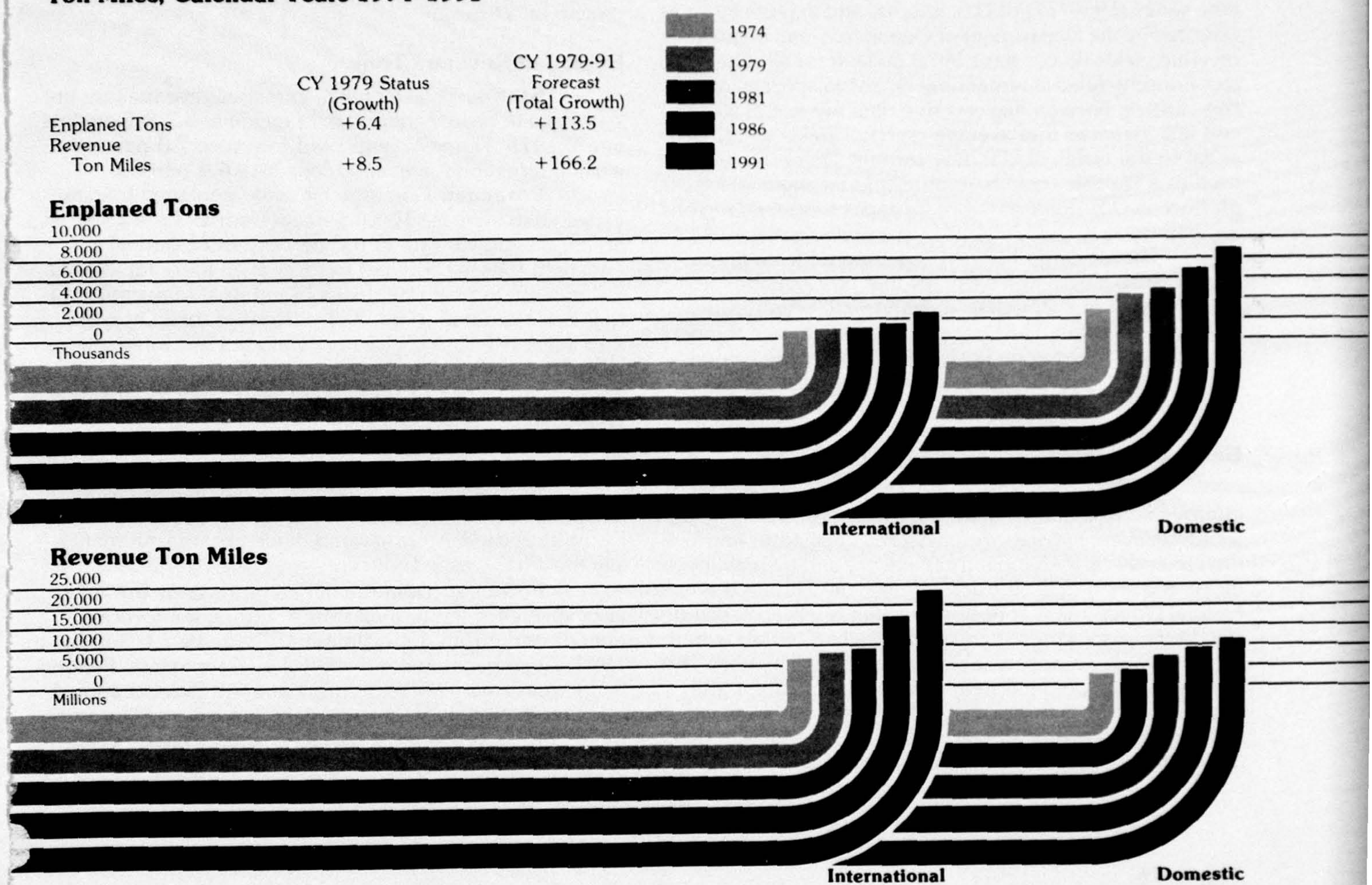


Figure 15.
Air Cargo Enplaned Revenue Tons and Revenue Ton Miles, Calendar Years 1974–1991

	CY 1979 Status (Growth)	CY 1979-91 Forecast (Total Growth)
Enplaned Tons	+6.4	+113.5
Revenue Ton Miles	+8.5	+166.2



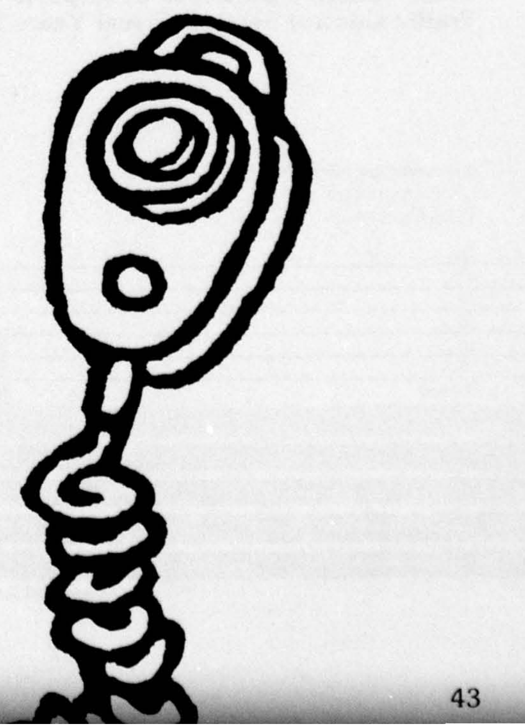
Air Cargo

Methodology and Assumptions

Appendix C of this volume contains a full explanation of the methodology and assumptions employed by the FAA in forecasting air cargo.

Forecasts are made for freight and express. Activity is assumed to be a function of the general economy of the United States and its world trading partners, the growth in time-sensitive cargo shipments and differences in quality and prices for air and surface transportation modes. The relationship between these quantifiable variables and air cargo traffic is estimated by econometric forecasting models. One model forecasts revenue ton miles for domestic air cargo. Forecasts of revenue ton-miles for imports from and exports to six world regions are derived from 12 other models.

The domestic model is based upon historical GNP data as reported by the Department of Commerce and upon revenue ton miles and average revenue yields (in constant 1972 dollars) for all scheduled and nonscheduled domestic air cargo services as reported by the CAB. The 1962-78 historical time period encompasses substantial variation in



economic activity, technological innovation, and an increasing awareness of the benefits of air service.

The international models are based on a 14-year time series (1964-77) of U.S. imports and exports by air as reported by the Department of Commerce and on average revenue yields (in constant 1972 dollars) for all scheduled and nonscheduled international air cargo services of U.S. flag carriers. Foreign flag revenue data are not available and it is assumed that average revenue yields would be equal to the yields of U.S. flag carriers. Domestic GNP is used as a variable for U.S. imports and an aggregate gross product (in U.S. dollars) is used for each of six world regions for exports.

The air cargo forecast is generated from an econometric model and assumes that no dramatic technological or sociopolitical change will occur in the forecast time frame. The forecast also assumes that shippers and receivers choose their transport mode based upon economic and time sensitivities, and that these choices will remain essentially unchanged in the future.

General Forecast

The period of the 1980s should be marked by improvements in loading, record keeping, dispatching, and pickup delivery services. Airlines are expected to improve their internal cargo-handling capabilities and their ability to move goods on and off trucks at airports. Should the Federal Government impose new cargo safety and security standards, costs would increase somewhat; but air cargo services would be more reliable and secure for shippers. The increasing value of land near airports may result in the development of new air cargo terminals located remote from existing airports. These facilities would have automated loading and unloading capabilities for trucks and rail cars and would be located where good rail and road connections with surrounding areas are available. Thus, these new developments might be expected to stimulate the growth of air cargo.

Enplaned Revenue Tons

Status: Total air cargo enplaned revenue tons are estimated to have increased 6.4 percent to 5.2 million tons in CY 1979. Domestic enplaned tons rose 7.0 percent, while international enplaned tons rose 4.4 percent.

Forecast: Domestic air cargo enplaned tons are expected to increase 105.6 percent from 1979 to 1991 at an annual growth rate of 6.2 percent. International enplaned tons are forecast to grow even more rapidly at a 7.7 percent annual rate. In 1979, international enplaned tons are estimated to be 20.7 percent of total air cargo tonnage carried by U.S. carriers, while in 1991 international tonnage will represent 23.6 percent. Total enplaned tons are forecast to rise 113.5 percent from 1979 to 1991 (see Figure 15).

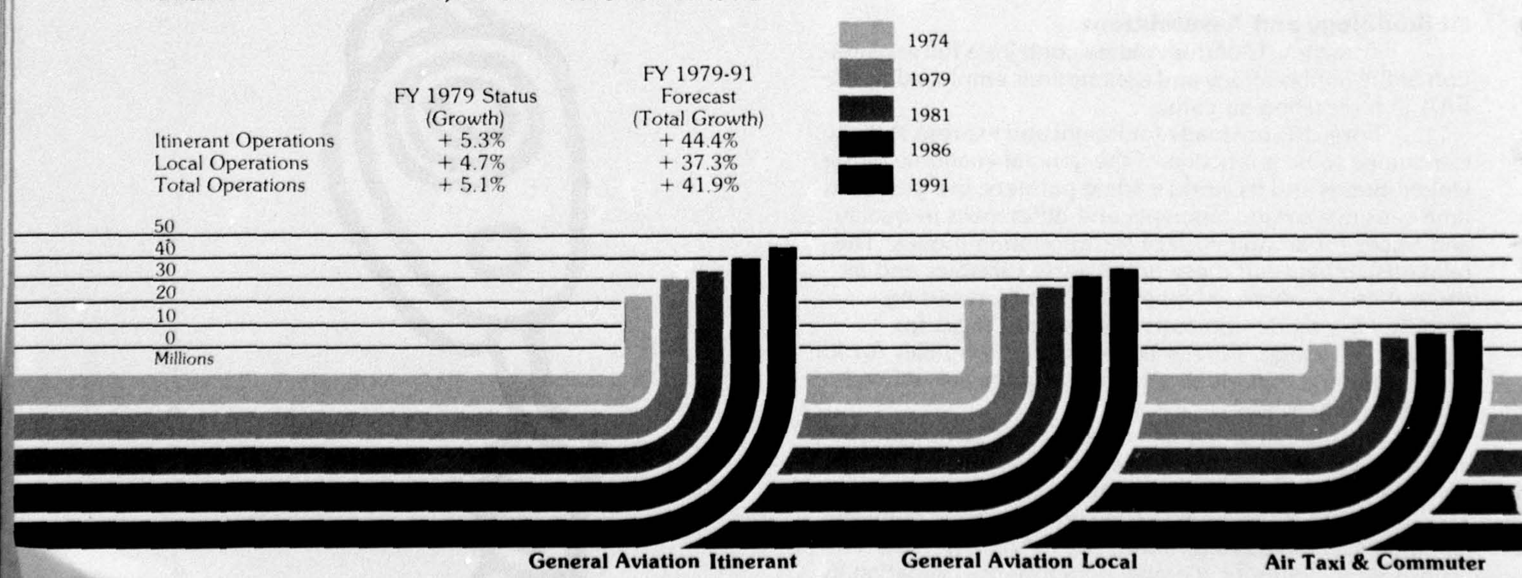
Revenue Ton Miles

Status: Total air cargo revenue ton miles were up 8.5 percent from 1978 to 13.0 billion in 1979. Domestically the increase was 8.8 percent, and internationally the total was 8.3 percent.

Forecast: Domestic air cargo revenue ton miles are expected to more than double during the forecast period, rising from 4.8 billion in 1979 to 10.7 billion by 1991. Average annual growth will be 6.9 percent. Freight and express are forecast to grow at a 7.8 percent annual rate. International air cargo revenue ton miles will increase more than 191.6 percent by 1991 at an average yearly growth rate of 9.3 percent.

Figure 16.
Total Aircraft Operations at Airports with FAA Traffic Control Service, Fiscal Years 1974–1991

	FY 1979 Status (Growth)	FY 1979-91 Forecast (Total Growth)
Itinerant Operations	+ 5.3%	+ 44.4%
Local Operations	+ 4.7%	+ 37.3%
Total Operations	+ 5.1%	+ 41.9%



Military Aviation

Methodology and Assumptions

All military aviation activity forecasts are based on information provided by the Department of Defense and the United States Coast Guard. Detailed military planning extends through 1987, and remaining year forecasts are projected at the 1987 level by the FAA. Military operations are expected to hold nearly constant throughout the forecast period. Basic military activity elements (aircraft and flying hours) are translated into expected FAA air traffic workloads.

Active Aircraft

Status: The number of active military aircraft in the continental United States has decreased steadily from 1973 to 1979. In 1979, the 18,623 military aircraft are distributed as follows: 8,621 jets, 1,820 turboprops, 880 pistons, and 7,302 helicopters.

Forecast: Active military aircraft are expected to remain at the present level (near 19,000) for the entire forecast period. During this period, the military proportion of the total national fleet will fall to 6.0 percent from the current 8.7 percent. Composition of the military fleet will show little change except for a further decline in piston-engined, fixed-wing aircraft to 1.6 percent of the total military fleet by 1991.

Aircraft Flying Hours

Status: Flying hours of U.S. military aircraft increased 5.2 percent to 5.1 million hours in 1979 over 1978.

Forecast: Total flying hours of military aircraft are expected to increase slightly from 5.1 to 5.3 million hours through 1991. Over this time period, the military proportion of total hours flown will fall to 6.8 percent from the current level of 10.0 percent.

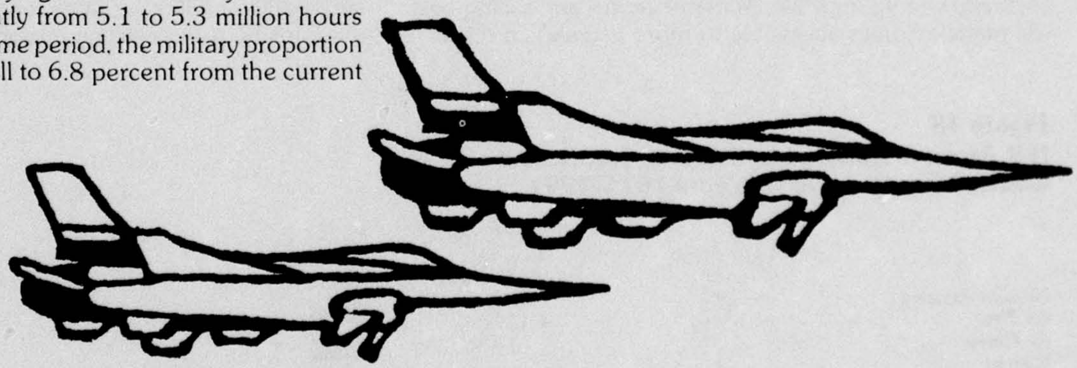
FAA Operational Services

Background

The Federal Aviation Administration (FAA) provides the aviation community with three distinct operational services: air traffic control at selected airports, IFR enroute traffic control, and flight services, including pilot briefings, the filing of flight plans, and aircraft contacts. These services are provided to four major categories of users: the air carriers, the air taxis, general aviation, and the military. Because of different relationships and growth trends among these four users, there is no one workload measure (such as airport operations) or aviation activity series (such as air carrier revenue passenger miles) which typifies past trends or the future outlook for all FAA services. There have been, and there will continue to be, different socioeconomic and political forces which drive the growth trends in each major user category.

Methodology and Assumptions

The aviation forecasts for major user categories (air carrier, air taxi, general aviation, military aviation) are the foundation for forecasts of FAA operational services. First, the underlying factors that influence growth patterns for each major user are determined and forecast. Based on these trends and past relationships, and through the use of econometric models, separate demand forecasts for FAA services are derived for each user category. Forecasts of total FAA operations and services are a summation of the individual forecasts for these major users.

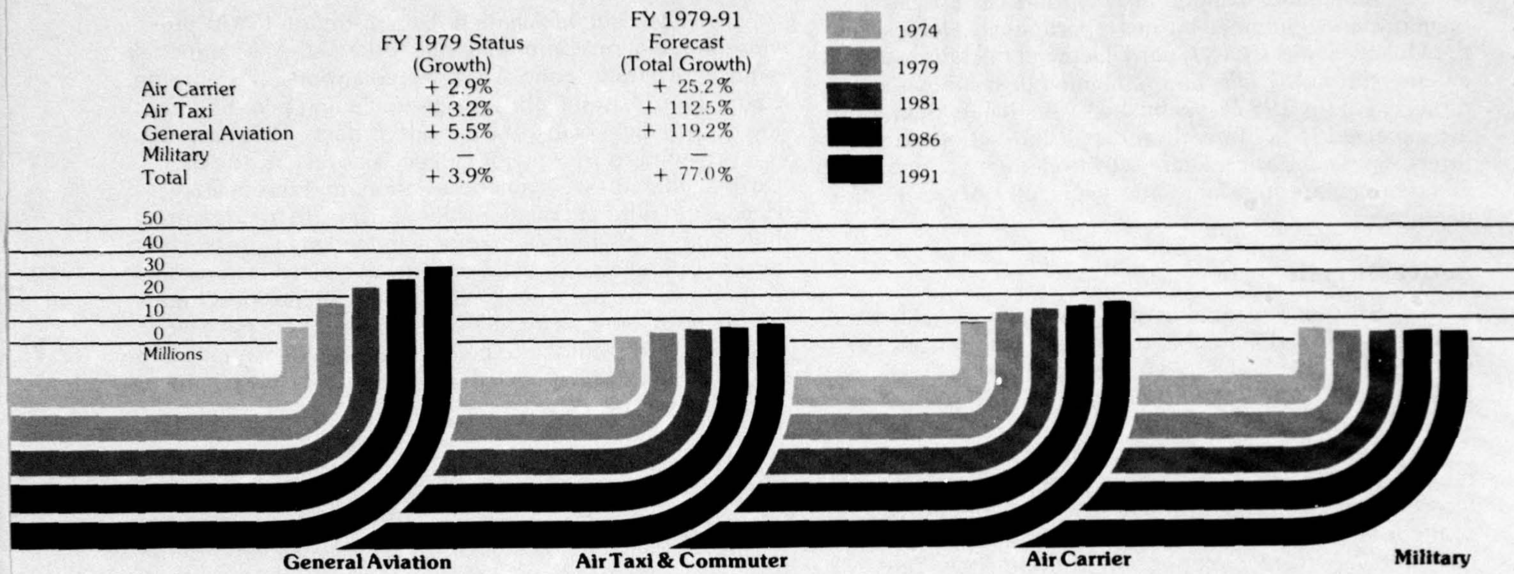


Air Carrier

Military

Figure 17.
Instrument Operations at Airports with FAA Traffic Control Service, Fiscal Years 1974-1991

	FY 1979 Status (Growth)	FY 1979-91 Forecast (Total Growth)
Air Carrier	+ 2.9%	+ 25.2%
Air Taxi	+ 3.2%	+ 112.5%
General Aviation	+ 5.5%	+ 119.2%
Military	—	—
Total	+ 3.9%	+ 77.0%



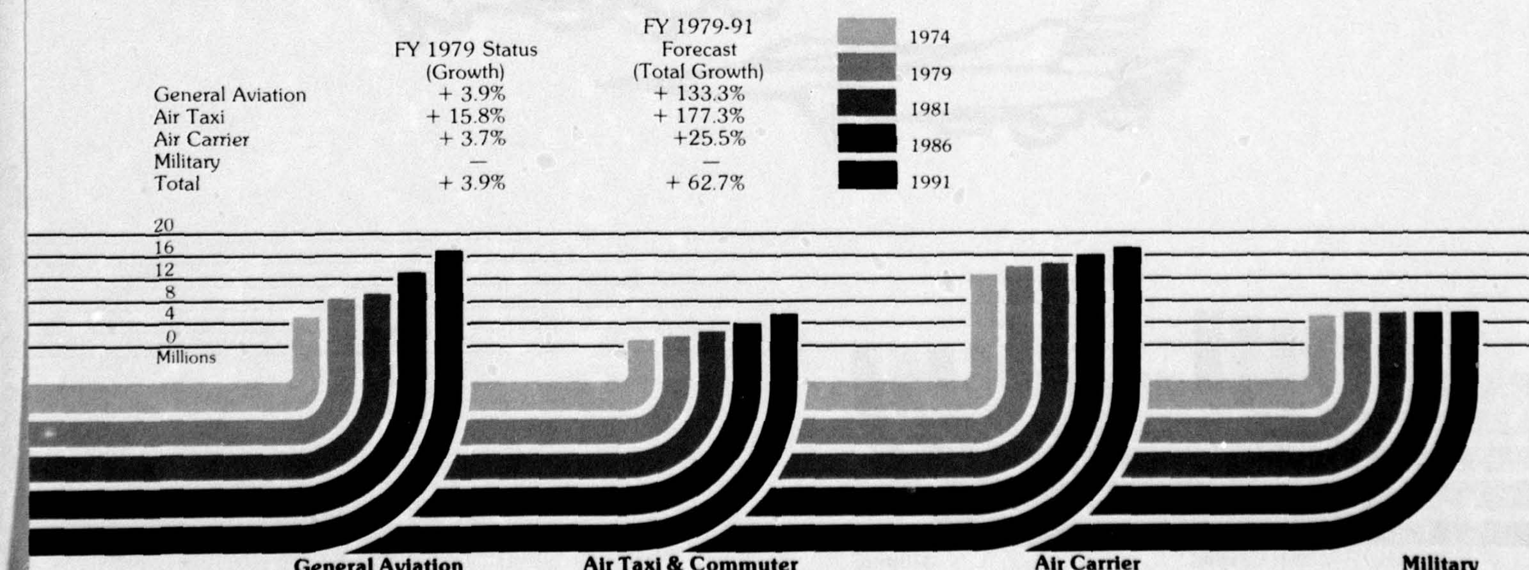
FAA Workload Forecast

Increased air carrier, commuter and air taxi operations will more than compensate for increased load-factors and larger aircraft to increase the FAA workload. Avionics will improve in sophistication and in the number of functions performed during the 1980s. Navigational accuracy should improve. Miniaturization and falling cost will make avionics accessible to more users. As a result, competition for controlled airspace will exert a positive effect on FAA workload measures.

In the 1980s, the need for increased capacity will be satisfied largely through improvements in existing air carrier airports, by improving reliever airports to serve as alternative landing facilities for general aviation traffic, and perhaps by using existing airports (such as Midway in

Figure 18.
IFR Aircraft Handled by FAA Air Route Traffic Control Centers, Fiscal Years 1974–1991

	FY 1979 Status (Growth)	FY 1979-91 Forecast (Total Growth)
General Aviation	+ 3.9%	+ 133.3%
Air Taxi	+ 15.8%	+ 177.3%
Air Carrier	+ 3.7%	+25.5%
Military	—	—
Total	+ 3.9%	+ 62.7%



Chicago) that lost traffic in the 1970s. At some airports, it may be possible to add short runways specifically for the use of air taxis and commuters, thus separating this traffic from long-haul jet airplanes. In addition, developments now being initiated to reduce wake turbulence are expected to increase capacity on existing runways.

By the early 1990s demand for airport services should be such that new airports or expansion of existing facilities will be required at several of the more congested hubs. This demand, plus improved financing capacity of airport sponsors, and an assumed availability of highspeed ground links from urban centers should make new airports feasible again. Lead times for airport construction will increase owing to difficulties associated with land acquisition, delays caused by environmental impact analyses, and coordination with state and local communities. Indeed, the escalating cost of land may make it advantageous to consider converting military airports to civilian use where practical.

Improved air traffic control technology will continue to be introduced during the 1980s to reduce congestion, increase efficiency, and improve safety. The FAA plans to increase automation as a way of coping with the increasing demand for aviation services. However, the growth in traffic volume will require increased manpower and facilities.

Total Aircraft Operations

Status: FY 1979 total aircraft operations (takeoffs and landings) at airports with FAA air traffic control towers will grow to 70.6 million according to preliminary data.

Forecast: Total aircraft operations at towered airports are forecast to increase at an average annual rate of 3.0 percent, or by a total of 41.9 percent by 1991. Long-term activity forecasts are quite similar to those published last year, with slightly higher forecasts of itinerant operations being offset by lower growth in general aviation local operations. The forecasts for air carriers and military aviation are essentially the same as last year, while the forecasts for air taxi and commuter operations are higher as a result of the effects of deregulation (see Figure 16).

Instrument Operations

Status: A 3.9 percent increase in instrument operations was recorded between FY 1978 and 1979. This growth reflects the increased use of avionics by the general aviation fleet, as well as strong growth in air taxi instrument operations.

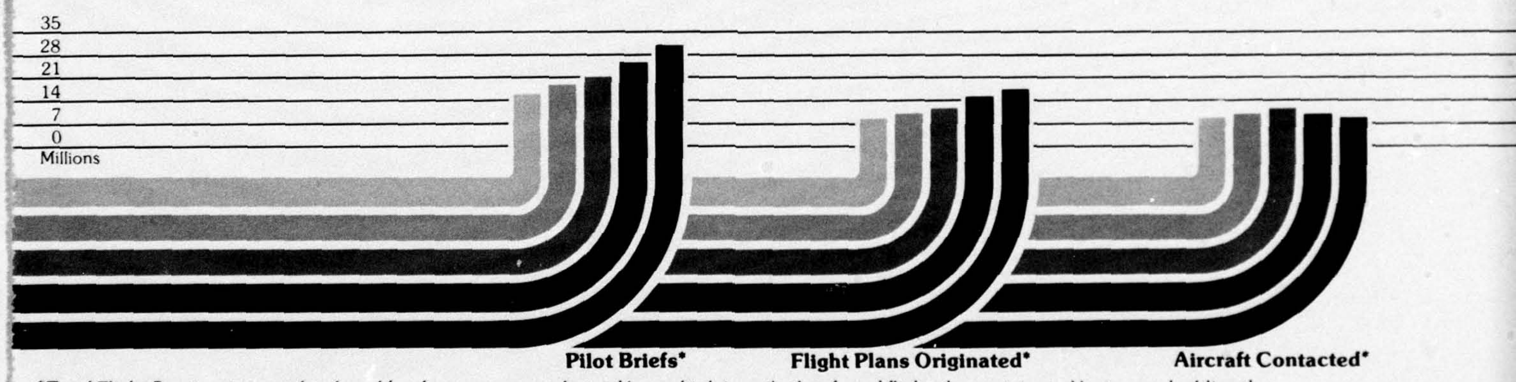
Forecast: Instrument operations at FAA towered airports are forecast to rise annually at an average of 3.9 percent, or a total of 58.0 percent by 1991. This forecast is higher than last year's forecast. Strong growth in air taxi instrument operations (112.5 percent by 1991) is attributable to increased commuter traffic and higher utilization of avionics. A significant increase (80.8 percent) in general aviation instrument operations is also expected (see Figure 17).

IFR Aircraft Handled

Status: In FY 1979, it is estimated that FAA Air Route Traffic Control Centers (ARTCC) handled 29.2 million IFR aircraft, a 3.9 percent increase over the 28.1

Figure 19.
Total Flight Services at FAA Flight Service Stations and Combined Station/Towers, Fiscal Years 1974–1991

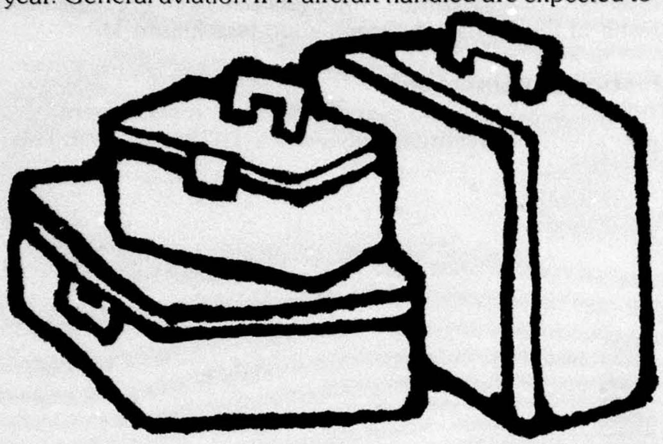
	FY 1979 Status (Growth)	FY 1979-91 Forecast (Total Growth)
Pilot Briefs	+ 3.8%	+ 64.7%
Flight Plans Originated	+ 7.7%	+ 73.5%
Aircraft Contacted	+ 2.9%	− 4.8%
Total	+ 4.9%	+ 56.5%



*Total Flight Services is a weighted workload measurement derived by multiplying pilot briefs and flight plans originated by two and adding the number of aircraft contacted. This figure depicts the components in their weighted form.

million recorded in FY 1978. Air carrier IFR aircraft handled increased 3.7 percent, while the number handled for general aviation rose 3.8 percent over the same period. Air carrier traffic accounts for about 48.3 percent of the current IFR volume, followed by general aviation (27.7 percent), the military (16.4 percent) and air taxis (7.5 percent).

Forecast: The forecast for workloads at ARTCCs through 1991 is only slightly lower than that projected last year. General aviation IFR-aircraft handled are expected to grow at a 6.0 percent annual rate from 1979 through 1991. Complementing this will be an expected 7.4 percent annual growth in air taxi IFR aircraft that are handled. Air carrier IFR operations should grow at a 1.9 percent annual rate. Zero growth is projected for military IFR activity (see Figure 18).



Flight Services

Status: FAA flight services include pilot briefings, the filing of flight plans and the contacting of aircraft. Historically, general aviation has generated the primary demand for flight services and this trend is expected to continue. Between 1978 and 1979, total flight services provided by flight service stations and combined station/towers rose by 4.9 percent from 64.9 million to 68.1 million. In 1979, pilot briefs rose 3.8 percent, aircraft contacted 2.9 percent, and flight plans 7.7 percent.

Forecast: Total flight services are expected to increase by 56.5 percent and to reach 106.6 million by 1991. This growth will derive from increased air traffic activity, greater sophistication among pilots and the improvements made possible by implementation of automated flight service equipment.

Chapter 4: Year-by-Year Data for FAA Aviation Forecasts, Fiscal Years 1980-1991

N437

Chapter 4 provides summary year-to-year data for the Federal Aviation Administration FY 1980-1991 Aviation Forecasts. The change in definition of certificated route air carriers which occurred this year should be noted. As of this year, intra-state and supplemental air carrier enplanements on scheduled flights are included in totals for the certificated route air carrier enplanements. Lack of data precludes addition of the intra-state and supplemental air carrier scheduled enplanements in the historical series.

Table 4
United States Certificated Route Air Carrier Scheduled Passenger Traffic

Fiscal Year	Revenue Passenger Enplanements (millions)			Revenue Passenger Miles (billions)		
Historical*	**Total**	**Domestic**	**International**	**Total**	**Domestic**	**International**
1970	171.4	156.9	14.5	129.0	104.1	24.9
1971	170.0	153.0	17.0	132.3	104.2	28.1
1972	182.9	164.5	18.4	144.2	112.3	32.0
1973	197.3	178.4	19.0	157.2	122.6	35.4
1974	208.1	189.5	18.6	165.0	130.0	35.0
1975	201.9	184.9	17.0	159.0	127.7	31.3
1976	211.8	195.1	16.7	169.5	137.3	32.2
1977	234.2	216.6	17.6	187.7	152.3	35.4
1978	266.7	246.7	20.0	218.9	176.8	42.1
1979E(1)	317.7	294.3	23.4	256.1	204.7	51.4
Forecast						
1980	338.2	313.1	25.1	273.7	218.5	55.2
1981	354.6	328.2	26.4	288.2	230.1	58.1
1982	368.8	341.3	27.5	301.0	240.2	60.8
1983	390.2	361.1	29.1	319.7	255.1	64.6
1984	409.0	378.4	30.6	336.5	268.6	67.9
1985	428.4	396.2	32.2	353.9	282.5	71.4
1986	448.6	414.8	33.8	372.0	297.0	75.0
1987	468.4	433.1	35.3	389.5	310.9	78.6
1988	485.8	449.1	36.7	405.5	323.7	81.8
1989	504.4	466.2	38.2	422.6	337.3	85.3
1990	523.1	483.4	39.7	439.8	351.1	88.7
1991	541.0	499.8	41.2	456.7	364.5	92.2

E Estimate *Source: CAB Air Carrier Traffic Statistics.
Prior to 1977, the fiscal year ended on June 30.
Detail may not add to total due to independent rounding.
(1) Introduces scheduled passenger traffic, principally intrastate air carrier traffic, not previously reported to Civil Aeronautics Board.

Table 5
U.S. Air Cargo Traffic(1)
All Services at U.S. Airports(2)

Calendar Year	Revenue Cargo Enplaned Tons(3) (thousands) Total	U.S.(1) Domestic	International	Revenue Cargo Ton-Miles(4) (millions) Total	U.S. Domestic	International
Historical*						
1974	4356	3427	929	9480	3632	5848
1975	3999	3182	817	9051	3470	5581
1976	4242	3379	863	9820	3664	6156
1977	4604	3587	1017	10828	3947	6881
1978	4887	3857	1030	11988	4419	7569
1979E	5201	4126	1075	13010	4809	8201
Forecast						
1980	5523	4367	1156	14018	5146	8872
1981	5957	4715	1242	15514	5607	9907
1982	6393	5057	1336	17127	6074	11053
1983	6819	5379	1440	18686	6515	12171
1984	7237	5687	1550	20186	6931	13255
1985	7757	6086	1671	22083	7461	14622
1986	8248	6448	1800	23870	7950	15920
1987	8753	6814	1939	25726	8443	17283
1988	9269	7179	2090	27646	8938	18708
1989	9850	7597	2253	29839	9502	20337
1990	10435	8006	2429	32042	10058	21984
1991	11102	8483	2619	34630	10712	23918

E-Estimate *Source: CAB Air Carrier Traffic Statistics and U.S. Department of Commerce, Bureau of the Census
(1) Includes Freight, Express and Mail
(2) Includes scheduled and nonscheduled service of all U.S. and Foreign Flag Carriers
(3) Exports only
(4) Includes Imports plus Exports

Table 6
Total Aircraft in the Service of United States Air Carriers

(as of January 1)

Aircraft Type	1979*	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total Aircraft	2623	2663	2706	2747	2789	2831	2873	2914	2965	3014	3064	3114	3164
Fixed-wing	2620	2660	2702	2743	2785	2826	2868	2909	2959	3008	3058	3107	3157
Jet	2291	2353	2417	2480	2544	2607	2671	2734	2806	2877	2952	3005	3069
2-engine	618	636	652	677	718	748	811	907	1007	1101	1200	1276	1354
3-engine	1164	1243	1306	1371	1433	1502	1517	1487	1455	1423	1392	1383	1373
4-engine	509	474	459	432	393	357	343	340	344	353	350	346	342
Turboprop	256	242	228	214	200	186	172	158	144	130	116	102	88
2-engine	178	168	158	148	138	128	118	108	98	88	78	68	58
4-engine	78	74	70	66	62	58	54	50	46	42	38	34	30
Piston	73	65	57	49	41	33	25	17	9	1	—	—	—
2-engine	28	25	22	19	16	13	10	7	4	1	—	—	—
4-engine	45	40	35	30	25	20	15	10	5	—	—	—	—
Helicopter	3	3	4	4	4	5	5	5	6	6	6	7	7

*Source: FAA Aircraft Utilization and Propulsion Reliability Report

Included here are all passenger and cargo aircraft owned or leased by, and in the domestic or international service of the United States certificated route, supplemental, intrastate, and commercial air carriers. Aircraft used for training and aircraft that have been withdrawn from service and are awaiting disposal are not included here. Aircraft in the service of air taxi operators are shown in the general aviation aircraft fleet on another page of this report.

Table 7
Total Airborne Hours, United States Air Carriers

by fiscal year (millions)

Aircraft Type	1979*	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total Aircraft	6.94	7.11	7.19	7.27	7.36	7.53	7.70	7.83	7.94	8.04	8.12	8.24	8.35
Fixed-wing	6.93	7.10	7.11	7.26	7.35	7.52	7.69	7.82	7.93	8.03	8.11	8.23	8.34
Jet	6.39	6.63	6.76	6.88	7.00	7.19	7.41	7.58	7.71	7.83	7.95	8.08	8.21
2-engine	1.58	1.64	1.67	1.69	1.76	1.88	2.04	2.30	2.57	2.82	3.09	3.31	3.52
3-engine	3.35	3.55	3.70	3.87	4.05	4.20	4.28	4.23	4.07	3.92	3.78	3.70	3.63
4-engine	1.46	1.43	1.39	1.32	1.19	1.11	1.09	1.05	1.07	1.09	1.08	1.07	1.06
Turboprop	.46	.40	.35	.33	.30	.29	.26	.23	.20	.19	.16	.15	.13
2-engine	.34	.29	.25	.23	.21	.20	.18	.16	.14	.13	.11	.10	.09
4-engine	.12	.11	.10	.10	.09	.09	.08	.07	.06	.06	.05	.05	.04
Piston	.08	.07	.07	.05	.05	.04	.02	.02	.02	.01	—	—	—
2-engine	.03	.03	.03	.02	.02	.02	.01	.01	.01	.01	—	—	—
4-engine	.05	.04	.04	.03	.03	.02	.01	.01	.01	—	—	—	—
Helicopter	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01	.01

*Source: Estimate based on FAA Aircraft Utilization and Propulsion Reliability Report

Included here are hours flown by all passenger and cargo aircraft that are owned or leased by and are in the domestic or international service of the United States certificated route, supplemental, intrastate, and contract air carriers.

Table 8
Total Statute Miles, United States Air Carriers

by fiscal year (millions)

Aircraft Type	1979*	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Total Aircraft	2897	2944	2999	3059	3113	3196	3264	3316	3363	3409	3451	3496	3529
Fixed-wing	2896	2943	2998	3058	3112	3195	3263	3315	3362	3408	3450	3495	3528
Jet	2767	2831	2902	2971	3042	3122	3197	3259	3311	3363	3410	3460	3498
2-engine	580	590	599	623	662	692	760	863	974	1084	1201	1299	1388
3-engine	1469	1563	1638	1720	1800	1892	1903	1883	1814	1745	1679	1638	1591
4-engine	718	678	665	628	580	538	534	513	523	534	530	523	519
Turboprop	109	94	81	75	70	65	59	52	49	44	40	35	30
2-engine	70	59	50	46	43	39	35	32	29	26	23	20	17
4-engine	39	35	31	29	27	26	24	22	20	18	17	15	13
Piston	20	18	15	12	10	8	7	4	2	1	—	—	—
2-engine	8	7	6	5	4	3	3	2	1	1	—	—	—
4-engine	12	11	9	8		5	4	2	1	—	—	—	—
Helicopter	1	1	1	1	1	1	1	1	1	1	1	1	1

*Source: Estimate based on FAA Aircraft Utilization and Propulsion Reliability Report

Included here are miles flown by all passenger and cargo aircraft owned or leased by, and in the domestic or international service of the United States certificated route, supplemental, intrastate, and contract air carriers.

Table 9
Estimated Active General Aviation Aircraft by Type of Aircraft
(in thousands)

As of January 1	Total	Fixed Wing: Piston: Single-Engine	Fixed Wing: Piston: Multi-Engine	Fixed Wing: Turboprop	Fixed Wing: Turbojet	Rotorcraft	Balloons Dirigibles Gliders
Historical*							
1974	153.5	126.2	18.7	1.8	1.4	3.1	2.2
1975	161.0	131.5	19.7	2.1	1.6	3.6	2.5
1976	168.0	136.6	20.3	2.5	1.7	4.1	2.8
1977	178.0	144.8	21.3	2.5	1.9	4.4	3.1
1978	184.3	149.3	21.5	2.9	2.3	4.7	3.6
1979E	193.0	155.2	23.0	3.3	2.6	5.1	3.8
Forecast							
1980	202.0	161.4	24.6	3.6	2.9	5.5	4.0
1981	214.2	170.8	26.2	3.9	3.2	5.9	4.2
1982	225.8	179.8	27.7	4.2	3.5	6.2	4.4
1983	237.1	188.3	29.2	4.6	3.8	6.5	4.7
1984	247.9	196.5	30.6	4.9	4.1	6.8	5.0
1985	257.7	203.8	31.9	5.3	4.4	7.1	5.2
1986	266.7	210.4	33.1	5.6	4.7	7.5	5.4
1987	275.0	216.4	34.3	5.9	5.0	7.8	5.6
1988	282.8	221.9	35.3	6.4	5.3	8.0	5.9
1989	290.2	227.1	36.3	6.9	5.6	8.2	6.1
1990	297.2	232.0	37.2	7.3	6.0	8.4	6.3
1991	303.8	236.4	38.0	7.7	6.4	8.8	6.5

E-Estimate *Source: FAA Statistical Handbook of Aviation.
Detail may not add to total because of independent rounding.
An active aircraft must have a current registration and it must have been flown during the previous calendar year.

Table 10
Estimated Active General Aviation Aircraft by FAA Region

(in thousands)

As of January 1	Total	FAA Region										
		ANE	AEA	ASO	AGL	ACE	ASW	ARM	AWE	ANW	AAL	APC
Historical*												
1974	153.3	5.5	19.8	23.2	29.0	11.1	20.7	7.9	23.9	8.3	3.3	.3
1975	161.0	6.2	21.1	24.3	30.6	11.6	21.6	8.3	25.0	8.6	3.4	.3
1976	168.0	6.4	21.1	24.8	30.9	12.3	23.0	9.3	25.8	9.8	4.2	.3
1977	178.0	6.4	21.7	26.1	32.5	13.3	24.2	10.0	27.4	11.0	4.7	.4
1978	184.3	6.6	21.7	26.9	33.2	13.6	25.8	11.1	28.4	11.4	4.9	.6
1979E	193.0	7.0	22.8	28.2	34.7	14.3	27.0	11.6	29.7	12.0	5.0	.6
Forecast												
1980	202.0	7.3	23.8	29.5	36.4	14.9	28.3	12.1	31.1	12.5	5.3	.6
1981	214.2	7.7	25.0	31.3	38.3	16.1	30.2	13.1	33.0	13.3	5.6	.6
1982	225.8	8.1	26.3	33.0	40.4	16.9	31.8	13.8	34.8	14.0	5.9	.7
1983	237.1	8.5	27.7	34.5	42.4	17.9	33.4	14.5	36.5	14.7	6.2	.7
1984	247.9	8.7	28.8	36.1	44.0	18.6	35.2	15.4	38.2	15.4	6.7	.7
1985	257.7	9.0	29.9	37.6	45.8	19.3	36.6	16.0	39.7	16.0	7.0	.8
1986	266.7	9.3	30.9	38.9	47.5	20.0	37.9	16.5	41.1	16.5	7.2	.8
1987	275.0	9.6	31.6	39.9	48.4	21.2	39.3	17.3	42.1	17.3	7.4	.8
1988	282.8	9.9	32.5	41.0	49.0	21.8	40.4	17.8	43.3	17.8	7.6	.8
1989	290.2	10.2	33.4	42.1	51.1	22.3	41.5	18.3	44.4	18.3	7.8	.9
1990	297.2	10.4	33.8	43.1	51.3	23.2	42.9	19.0	45.5	18.7	8.3	.9
1991	303.8	10.6	34.6	44.1	52.6	23.7	43.7	19.4	46.5	19.1	8.5	.9

E-Estimate *Source: FAA Statistical Handbook of Aviation.
Detail may not add to total because of independent rounding.
Totals include a small number of aircraft located in foreign countries. Also see Table 9 footnotes.

Table 10
Estimated Active General Aviation Aircraft by FAA Region
(in thousands)

As of January 1	Total	ANE	AEA	ASO	AGL	ACE	ASW	ARM	AWE	ANW	AAL	APC
		FAA Region										
Historical*												
1974	153.3	5.5	19.8	23.2	29.0	11.1	20.7	7.9	23.9	8.3	3.3	.3
1975	161.0	6.2	21.1	24.3	30.6	11.6	21.6	8.3	25.0	8.6	3.4	.3
1976	168.0	6.4	21.1	24.8	30.9	12.3	23.0	9.3	25.8	9.8	4.2	.3
1977	178.0	6.4	21.7	26.1	32.5	13.3	24.2	10.0	27.4	11.0	4.7	.4
1978	184.3	6.6	21.7	26.9	33.2	13.6	25.8	11.1	28.4	11.4	4.9	.6
1979E	193.0	7.0	22.8	28.2	34.7	14.3	27.0	11.6	29.7	12.0	5.0	.6
Forecast												
1980	202.0	7.3	23.8	29.5	36.4	14.9	28.3	12.1	31.1	12.5	5.3	.6
1981	214.2	7.7	25.0	31.3	38.3	16.1	30.2	13.1	33.0	13.3	5.6	.6
1982	225.8	8.1	26.3	33.0	40.4	16.9	31.8	13.8	34.8	14.0	5.9	.7
1983	237.1	8.5	27.7	34.5	42.4	17.9	33.4	14.5	36.5	14.7	6.2	.7
1984	247.9	8.7	28.8	36.1	44.0	18.6	35.2	15.4	38.2	15.4	6.7	.7
1985	257.7	9.0	29.9	37.6	45.8	19.3	36.6	16.0	39.7	16.0	7.0	.8
1986	266.7	9.3	30.9	38.9	47.5	20.0	37.9	16.5	41.1	16.5	7.2	.8
1987	275.0	9.6	31.6	39.9	48.4	21.2	39.3	17.3	42.1	17.3	7.4	.8
1988	282.8	9.9	32.5	41.0	49.0	21.8	40.4	17.8	43.3	17.8	7.6	.8
1989	290.2	10.2	33.4	42.1	51.1	22.3	41.5	18.3	44.4	18.3	7.8	.9
1990	297.2	10.4	33.8	43.1	51.3	23.2	42.9	19.0	45.5	18.7	8.3	.9
1991	303.8	10.6	34.6	44.1	52.6	23.7	43.7	19.4	46.5	19.1	8.5	.9

E-Estimate   *Source: FAA Statistical Handbook of Aviation.
Detail may not add to total because of independent rounding.
Totals include a small number of aircraft located in foreign countries. Also see Table 9 footnotes.

Table 11
Estimated Hours Flown in General Aviation by Type of Aircraft

(in millions)

Fiscal Year	Total	Fixed Wing: Piston: Single-Engine	Fixed Wing: Piston: Multi-Engine	Fixed Wing: Turboprop	Fixed Wing: Turbojet	Rotorcraft	Balloons Dirigibles Gliders
Historical*							
1974	30.7	22.1	5.2	1.2	.7	1.3	.2
1975	31.7	22.7	5.3	1.3	.8	1.5	.2
1976	33.0	23.6	5.3	1.3	.9	1.7	.3
1977	35.3	24.8	5.9	1.5	1.1	1.8	.3
1978	37.1	25.9	6.2	1.6	1.2	1.9	.3
1979E	39.0	27.0	6.4	1.8	1.4	2.1	.3
Forecast							
1980	41.2	28.2	6.8	2.0	1.6	2.3	.3
1981	43.8	29.7	7.2	2.2	1.8	2.5	.4
1982	46.1	31.1	7.7	2.4	1.9	2.6	.4
1983	48.2	32.4	8.2	2.5	2.0	2.7	.4
1984	50.5	33.7	8.6	2.7	2.2	2.9	.4
1985	52.6	34.9	9.0	2.8	2.4	3.1	.4
1986	54.6	36.0	9.4	3.0	2.5	3.2	.5
1987	56.5	37.1	9.7	3.2	2.7	3.3	.5
1988	58.3	38.1	10.0	3.4	2.9	3.4	.5
1989	60.2	39.1	10.3	3.7	3.1	3.5	.5
1990	62.1	40.1	10.7	3.9	3.3	3.6	.5
1991	64.0	41.0	11.0	4.2	3.5	3.7	.6

E-Estimate *Source: FAA Statistical Handbook of Aviation.
Prior to 1977, the fiscal year ended on June 30.
Detail may not add to total because of independent rounding.

Table 12
Commuter Airlines Aircraft Operations
(in millions)

Calendar Year	Total	Puerto Rico	Transfers	New Points	Current Points
Historical*					
1974	2.0	.3	—	—	1.7
1975	2.2	.3	—	—	1.9
1976	2.4	.3	—	—	2.1
1977	2.8	.3	—	—	2.5
1978	3.1	.3	—	—	2.8
1979E	3.3	.3	—	—	3.0
Forecast					
1980	3.6	.3	.1	.1	3.1
1981	4.0	.4	.2	.2	3.2
1982	4.1	.4	.2	.3	3.2
1983	4.4	.4	.3	.4	3.3
1984	4.6	.4	.3	.4	3.5
1985	4.7	.4	.4	.4	3.5
1986	5.0	.5	.5	.4	3.6
1987	5.2	.5	.5	.4	3.8
1988	5.3	.5	.6	.4	3.8
1989	5.5	.5	.6	.4	4.0
1990	5.6	.5	.6	.4	4.1
1991	5.6	.5	.6	.4	4.1

E-Estimate *Source: Civil Aeronautics Board
Based on an average passenger boarding factor of 5.7 in 1978 increasing to 7.2 in 1991.

Table 13
Commuter Airlines Passenger Traffic[1]

Revenue Passenger Enplanements (millions)

Calendar Year	Total	Current Points[2]	Puerto Rico	Transfers[3]	New Points[4]
Historical*					
1974	6.0	4.8	1.2	—	—
1975	5.8	4.7	1.1	—	—
1976	6.2	5.2	1.0	—	—
1977	7.4	6.4	1.0	—	—
1978	8.8	7.8	1.0	—	—
1979E	9.9	8.8	1.1	—	—
Forecast					
1980	10.7	9.1	1.1	.2	.3
1981	11.5	9.6	1.2	.3	.4
1982	12.3	10.0	1.3	.4	.6
1983	13.1	10.5	1.3	.5	.7
1984	13.9	11.0	1.4	.7	.8
1985	14.8	11.6	1.5	.8	.8
1986	15.7	12.2	1.6	1.0	.9
1987	16.6	12.7	1.6	1.1	.9
1988	17.6	13.4	1.7	1.3	.9
1989	18.6	14.1	1.7	1.4	.9
1990	19.7	15.0	1.8	1.5	.9
1991	20.3	15.9	1.8	1.6	1.0

Revenue Passenger Miles (millions)

	Total	Current Points	Puerto Rico	Transfers[5]	New Points[5]
Historical*					
1974	633.7	552.8	80.9	—	—
1975	612.3	537.8	74.5	—	—
1976	665.7	593.6	72.1	—	—
1977	836.5	766.3	70.2	—	—
1978	997.9	921.3	76.6	—	—
1979E	1226.8	1049.8	77.0	—	—
Forecast					
1980	1232.3	1094.8	77.3	24.1	36.1
1981	1334.1	1164.8	84.4	36.4	48.5
1982	1426.2	1213.5	91.4	48.5	72.8
1983	1534.9	1295.4	91.4	61.7	86.4
1984	1653.3	1368.3	98.4	87.1	99.5
1985	1760.9	1454.8	105.5	100.3	100.3
1986	1895.1	1542.4	112.5	126.4	113.8
1987	1986.2	1618.6	112.7	140.2	114.7
1988	2123.6	1721.5	119.5	167.0	115.6
1989	2243.1	1825.8	119.5	181.3	116.5
1990	2397.5	1957.7	126.5	195.8	117.5
1991	2559.8	2091.3	126.5	210.5	131.5

E-Estimate *Source: Civil Aeronautics Board Detail may not add to total due to independent rounding.

1 48 contiguous states plus Puerto Rico

2 Enplanements at current points, exclusive of Puerto Rico.

3 Based on 74 mainland certificated cities enplaning less than 40 passengers daily. These cities were grouped in the same categories used for existing exclusive commuter points and the corresponding models used to derive estimates of enplanements at these new points. The estimates were then doubled to represent enplanements at the corresponding hubs, and phased in over five years beginning in 1979.

4 Based on 50 potential new mainland service points. The forecast methodology is similar to that used for the transfer points, the phase-in period is ten years.

5 Based on same average trip lengths as for current points.

Table 14
Estimated Fuel Consumed by United States Domestic Civil Aviation

(in millions of gallons)

Fiscal Year	Total Jet Fuel and Aviation Gasoline	Jet Fuel			Aviation Gasoline		
		Total	Air Carrier	General Aviation	Total	Air Carrier	General Aviation
Historical*							
1974	8,783	8,320	7,963	357	463	20	443
1975	8,745	8,313	7,860	453	432	20	412
1976	8,769	8,317	7,822	495	452	20	432
1977	9,396	8,921	8,385	536	475	19	456
1978	9,770	9,279	8,669	552	491	17	474
1979E	10,433	9,920	9,275	645	513	15	498
Forecast							
1980	10,886	10,348	9,609	739	538	13	525
1981	11,328	10,759	9,926	833	569	11	558
1982	11,711	11,115	10,234	881	596	9	587
1983	12,042	11,419	10,489	930	623	7	616
1984	12,550	11,902	10,877	1,025	648	5	643
1985	13,008	12,335	11,215	1,120	673	4	669
1986	13,329	12,631	11,461	1,170	698	3	695
1987	13,733	13,014	11,748	1,266	719	2	717
1988	14,122	13,381	12,018	1,363	741	1	740
1989	14,502	13,751	12,294	1,457	751	—	751
1990	14,912	14,128	12,577	1,551	784	—	784
1991	15,319	14,512	12,867	1,645	807	—	807

E-Estimate *Source: FAA AVP Estimates

Prior to 1977, the fiscal year ended on June 30.

Domestic civil aviation is defined for purposes of the table to include all civil aircraft flights which originate and terminate within the 50 states. Estimates of fuel consumed by airframe and aircraft engine manufactures, whether for flight testing or ground testing, are not shown here because they are not available for domestic industry as a whole and estimates cannot be developed with any assurance of accuracy. Estimates of fuel consumed by the supplemental, contract and intrastate carriers are included in the "Air Carrier" columns. It should also be noted that general aviation fuel consumption is not reported and historical series are estimates.

Table 15
Active U.S. Military Aircraft in Continental United States(1) 1974-1991

Fiscal Year	Total	Fixed Wing Aircraft			Helicopter
		Jet	Turboprop	Piston	
Historical*					
1974	21,143	9,091	1,207	2,854	7,991
1975	19,889	9,526	1,298	1,927	7,138
1976	19,775	9,255	1,511	1,360	7,649
1977	18,670	9,168	1,382	1,075	7,045
1978	18,931	8,898	1,794	1,056	7,183
1979E	18,623	8,621	1,820	880	7,302
Forecast					
1980	18,640	8,763	1,851	681	7,345
1981	18,871	8,939	1,888	465	7,579
1982	19,226	9,119	1,906	451	7,750
1983	19,403	9,203	1,922	407	7,871
1984	19,562	9,210	1,952	400	8,000
1985	19,708	9,175	1,970	384	8,179
1986	19,644	9,145	1,996	325	8,178
1987(2)	19,636	9,201	1,994	310	8,131
1988	19,598	9,201	1,994	310	8,093
1989	19,554	9,201	1,994	310	8,049
1990	19,531	9,201	1,994	310	8,026
1991	19,501	9,201	1,994	310	7,996

E-Estimate *Source: Office of the Secretary of Defense, Department of Defense.
Prior to 1977, the fiscal year ended June 30.
1) Includes Army, Air Force, Navy and Marine regular service aircraft, as well as Reserve and National Guard aircraft.
2) Detailed planning information not available beyond 1987. 1988-1991 projected at 1987 level.

Table 16
Active U.S. Military Aircraft Flying Hours in Continental United States(1) 1974-1991

(thousands)

Fiscal Year	Total	Fixed-Wing Aircraft Jet	Turboprop	Piston	Helicopter
Historical*					
1974	6,403	3,287	533	1,051	1,532
1975	6,510	3,478	677	902	1,453
1976(2)	5,928	3,109	646	559	1,614
1977	5,401	2,932	577	489	1,403
1978	4,837	2,843	595	328	1,071
1979E	5,090	3,006	654	357	1,073
Forecast					
1980	5.142	3,048	661	343	1,090
1981	5,133	3,105	636	310	1,082
1982	5,168	3,145	625	289	1,109
1983	5,197	3,180	628	282	1,107
1984	5,220	3,195	629	282	1,114
1985	5,273	3,249	630	280	1,114
1986	5,270	3,247	630	279	1,114
1987(3)	5,286	3,264	632	276	1,114
1988	5,286	3,264	632	276	1,114
1989	5,286	3,264	632	276	1,114
1990	5,286	3,264	632	276	1,114
1991	5,286	3,264	632	276	1,114

E-Estimate *Source: Office of the Secretary of Defense, Department of Defense
Prior to 1977, the fiscal year ended June 30.
(1) Includes Army, Air Force, Navy and Marine regular service aircraft, as well as Reserve and National Guard Aircraft.
(2) Includes Navy data for fiscal 1977 transition quarter (July, August and September 1976).
(3) Detailed planning information not available beyond 1987. 1988-1991 projected at 1987 level.

Table 17
Total Itinerant and Local Aircraft Operations at Airports with FAA Traffic Control Service

(in millions)

Fiscal Year	Total	Itinerant	Local	Number of Towers
Historical*				
1970	56.2	34.9	21.2	331
1971	54.2	33.6	20.6	343
1972	53.6	33.6	20.1	348
1973	53.9	34.0	19.9	362
1974	56.8	36.1	20.8	394
1975	58.9	37.6	21.4	416
1976	62.5	39.7	22.8	423
1977	66.7	42.4	24.3	426
1978	67.2	43.6	23.6	428
1979E	70.6	45.9	24.7	430
Forecast				
1980	73.9	48.1	25.8	435
1981	77.0	50.1	26.9	440
1982	80.1	52.2	27.9	445
1983	83.3	54.4	28.9	450
1984	86.4	56.6	29.8	455
1985	89.3	58.7	30.6	460
1986	91.4	60.0	31.4	465
1987	93.5	61.4	32.1	470
1988	95.4	62.7	32.7	475
1989	97.1	63.9	33.2	480
1990	98.7	65.1	33.6	485
1991	100.2	66.3	33.9	490

E-Estimate *Source: FAA Air Traffic Activity.
Detail may not add to total due to independent rounding.
Prior to 1977, the fiscal year ended June 30.
An aircraft operation is defined as an aircraft arrival at or a departure from an airport with FAA traffic control service. A local operation is performed by an aircraft that: operates in the local traffic pattern or within sight of the tower; is known to be departing for or arriving from flight in local practice areas; or executes simulated instrument approaches or low passes at the airport. All aircraft arrivals and departures other than local (as defined above) are classified as itinerant operations.

Table 18
Itinerant Aircraft Operations at Airports with FAA Traffic Control Service

(in millions)

Fiscal Year	Total	Air Carrier	Air Taxi	General Aviation	Military
Historical*					
1970	34.9	10.8	—	22.6	1.5
1971	33.6	10.1	—	22.0	1.5
1972	33.6	9.7	2.0	20.4	1.5
1973	34.0	9.8	2.1	20.6	1.5
1974	36.1	9.5	2.4	22.9	1.3
1975	37.6	9.4	2.7	24.2	1.3
1976	39.7	9.3	2.9	26.2	1.3
1977	42.4	9.8	3.3	28.1	1.3
1978	43.6	10.1	3.8	28.5	1.2
1979E	45.9	10.4	4.3	30.0	1.2
Forecast					
1980	48.1	10.7	4.7	31.5	1.2
1981	50.1	10.9	5.0	33.0	1.2
1982	52.2	11.1	5.4	34.5	1.2
1983	54.4	11.4	5.8	36.0	1.2
1984	56.6	11.6	6.3	37.5	1.2
1985	58.7	11.8	6.7	39.0	1.2
1986	60.0	12.0	7.1	39.7	1.2
1987	61.4	12.3	7.5	40.4	1.2
1988	62.7	12.5	7.9	41.1	1.2
1989	63.9	12.7	8.2	41.8	1.2
1990	65.1	12.9	8.5	42.5	1.2
1991	66.3	13.1	8.8	43.2	1.2

E-Estimate *Source: FAA Air Traffic Activity.
Prior to 1977, the fiscal year ended June 30.
Detail may not add to total due to independent rounding.
See Table 17 for definition of itinerant operations. Air taxi included with general aviation prior to 1972.
Air taxi includes commuter

Table 19
Local Aircraft Operations at Airports with FAA Traffic Control Service

(in millions)

Fiscal Year	Total	General Aviation	Military
Historical*			
1970	21.2	19.4	1.9
1971	20.6	18.6	2.0
1972	20.1	18.1	2.0
1973	19.9	18.1	1.8
1974	20.8	19.3	1.5
1975	21.4	20.0	1.4
1976	22.8	21.4	1.4
1977	24.3	22.9	1.4
1978	23.6	22.3	1.3
1979E	24.7	23.4	1.3
Forecast			
1980	25.8	24.5	1.3
1981	26.9	25.6	1.3
1982	27.9	26.6	1.3
1983	28.9	27.6	1.3
1984	29.8	28.5	1.3
1985	30.6	29.3	1.3
1986	31.4	30.1	1.3
1987	32.1	30.8	1.3
1988	32.7	31.4	1.3
1989	33.2	31.9	1.3
1990	33.6	32.3	1.3
1991	33.9	32.6	1.3

E-Estimate *Source FAA Air Traffic Activity
Prior to 1977, the fiscal year ended on June 30.
Detail may not add to total due to independent rounding.
See Table 17 for definition of local operations.

Table 20
Instrument Operations at Airports with FAA Traffic Control Service

(in millions)

Fiscal Year	Total		Air Carrier	Air Taxi	General Aviation	Military
Historical*						
1970	17.5		10.2	—	4.1	3.2
1971	17.5		9.5	—	4.6	3.4
1972	19.4		9.6	.9	5.0	3.9
1973	22.5	(1.5)	9.8	1.1	7.4	4.2
1974	24.1	(2.6)	9.5	1.4	9.2	4.0
1975	26.1	(2.9)	9.5	1.9	10.7	3.9
1976	28.1	(6.2)	9.5	2.2	12.8	3.7
1977	31.5	(7.4)	10.1	2.6	15.2	3.8
1978	33.5	(7.8)	10.4	3.1	16.3	3.7
1979E	34.8	(8.2)	10.7	3.2	17.2	3.7
Forecast						
1980	40.1	(11.1)	11.0	3.6	21.8	3.7
1981	41.7	(11.2)	11.2	3.8	23.0	3.7
1982	42.8	(11.3)	11.4	4.2	23.5	3.7
1983	44.4	(11.4)	11.7	4.7	24.3	3.7
1984	45.5	(11.7)	11.9	4.9	25.0	3.7
1985	47.3	(11.9)	12.1	5.3	26.2	3.7
1986	49.2	(12.0)	12.3	5.6	27.6	3.7
1987	51.0	(12.1)	12.6	5.9	28.8	3.7
1988	53.2	(12.2)	12.8	6.2	30.5	3.7
1989	53.9	(12.3)	13.0	6.5	30.7	3.7
1990	54.6	(12.4)	13.3	6.7	30.9	3.7
1991	55.0	(12.6)	13.4	6.8	31.1	3.7

E-Estimate *Source: FAA Air Traffic Activity
Prior to 1977, the fiscal year ended June 30.
An instrument operation is defined as the handling by an FAA terminal traffic control facility of the arrival, departure, or overflight at an airport of an aircraft on an IFR flight plan or the provision of IFR separation to other aircraft by an FAA terminal traffic control facility. Non-IFR instrument counts at Terminal Control Area (TCA) facilities and Stage III of expanded area radar service are included in the totals and noted in parenthesis as an information item (see Table 21).
The data include instrument operations at FAA-operated military radar approach control facilities.
Air taxi includes commuter.

Table 21
Non-IFR Instrument Operations
(in millions)

Fiscal Year	Total	Terminal Control Areas—TCA's	Expanded Area Radar Service Stage III As of 6/30/75
Historical*			
1973	1.5	—	1.5
1974	2.6	—	2.6
1975	2.9	—	2.9
1976	6.2	1.7	4.5
1977	7.4	2.0	5.4
1978	7.8	2.1	5.7
1979E	8.2	2.3	5.9
Forecast			
1980	11.1	2.8	8.3
1981	11.2	2.8	8.4
1982	11.3	2.8	8.5
1983	11.4	2.8	8.6
1984	11.7	2.8	8.9
1985	11.9	2.9	9.0
1986	12.0	3.0	9.0
1987	12.1	3.0	9.1
1988	12.2	3.1	9.1
1989	12.3	3.1	9.2
1990	12.4	3.1	9.3
1991	12.6	3.2	9.4

E-Estimate *Source: FAA Air Traffic Activity.
Prior to 1977, the fiscal year ended June 30.
TCA count not available prior to 1976.

Table 22
IFR Aircraft Handled
FAA Air Route Traffic Control Centers

(in millions)

	Total			Aircraft Handled			
Fiscal* Year	Aircraft Handled	IFR Departures	Overs	Air Carrier	Air Taxi	General Aviation	Military
Historical*							
1970	21.6	8.4	4.9	13.5	—	3.6	4.5
1971	21.3	8.2	5.0	13.0	—	3.8	4.6
1972	22.0	8.5	5.1	12.4	.8	3.9	4.9
1973	22.8	8.9	5.1	12.6	.9	4.6	4.7
1974	22.9	9.0	5.0	12.4	1.1	5.1	4.3
1975	23.6	9.3	5.1	12.4	1.3	5.5	4.4
1976	23.9	9.4	5.1	12.4	1.4	6.0	4.2
1977	26.0	10.2	5.6	13.0	1.6	6.9	4.5
1978	28.1	11.0	6.0	13.6	1.9	7.8	4.7
1979E	29.2	11.4	6.3	14.1	2.2	8.1	4.8
Forecast							
1980	30.7	12.1	6.5	14.4	2.5	9.0	4.8
1981	31.8	12.6	6.6	14.6	2.7	9.7	4.8
1982	33.2	13.2	6.8	14.9	2.9	10.6	4.8
1983	35.0	13.9	7.2	15.2	3.4	11.6	4.8
1984	36.1	14.4	7.3	15.4	3.6	12.3	4.8
1985	37.3	14.9	7.5	15.7	3.8	13.0	4.8
1986	38.7	15.5	7.7	16.0	4.2	13.7	4.8
1987	40.1	16.1	7.9	16.5	4.4	14.4	4.8
1988	41.1	16.5	8.1	16.8	4.6	14.9	4.8
1989	42.0	16.9	8.2	17.1	4.8	15.3	4.8
1990	43.0	17.3	8.4	17.4	5.0	15.8	4.8
1991	44.0	17.7	8.6	17.7	5.2	16.3	4.8

E-Estimate *Source: FAA Air Traffic Activity.
Prior to 1977, the fiscal year ended June 30.
Detail may not add to total due to independent rounding.
The aircraft handled count consists of the number of IFR departures multiplied by two plus the number of overs. This concept recognizes that for each departure there is a landing. An IFR departure is defined as an original IFR flight plan filed either prior to departure or after becoming airborne. An overflight originates outside the ARTCC area and passes through the area without landing. Air taxi includes commuter.

Table 23
IFR Departures and Overs
FAA Air Route Traffic Control Centers
(in millions)

Fiscal Year	Air Carrier IFR Departures	Air Carrier Overs	Air Taxi IFR Departures	Air Taxi Overs	General Aviation IFR Departures	General Aviation Overs	Military IFR Departures	Military Overs
Historical*								
1970	5.2	3.1	—	—	1.5	.5	1.6	1.3
1971	4.9	3.1	—	—	1.6	.5	1.6	1.4
1972	4.6	3.2	.4	0	1.7	.6	1.8	1.2
1973	4.7	3.2	.4	0	2.0	.6	1.7	1.1
1974	4.6	3.1	.5	0	2.2	.7	1.6	1.1
1975	4.6	3.1	.6	.1	2.4	.7	1.6	1.2
1976	4.6	3.2	.7	.1	2.6	.8	1.5	1.1
1977	4.8	3.4	.8	.1	3.0	.9	1.6	1.2
1978	5.0	3.6	.9	.1	3.4	1.0	1.7	1.3
1979E	5.2	3.7	1.0	.1	3.5	1.1	1.7	1.4
Forecast								
1980	5.3	3.8	1.2	.1	3.9	1.2	1.7	1.4
1981	5.4	3.8	1.3	.1	4.2	1.3	1.7	1.4
1982	5.5	3.9	1.4	.1	4.6	1.4	1.7	1.4
1983	5.6	4.0	1.6	.2	5.0	1.6	1.7	1.4
1984	5.7	4.0	1.7	.2	5.3	1.7	1.7	1.4
1985	5.8	4.1	1.8	.2	5.6	1.8	1.7	1.4
1986	5.9	4.2	2.0	.2	5.9	1.9	1.7	1.4
1987	6.1	4.3	2.1	.2	6.2	2.0	1.7	1.4
1988	6.2	4.4	2.2	.2	6.4	2.1	1.7	1.4
1989	6.3	4.5	2.3	.2	6.6	2.1	1.7	1.4
1990	6.4	4.6	2.4	.2	6.8	2.2	1.7	1.4
1991	6.5	4.7	2.5	.2	7.0	2.3	1.7	1.4

E-Estimate *Source: FAA Air Traffic Activity.
Prior to 1977, the fiscal year ended June 30. Air taxi included with general aviation prior to 1972. Air taxi includes commuter.

Table 24
Total Flight Services, Pilot Briefs and Flight Plans Originated at FAA Flight Service Stations and Combined Station/Towers

(in millions)

			Flight Plans Originated		
Fiscal Year	**Total Flight Services**	**Pilot Briefs**	**Total**	**IFR-DVFR**	**VFR**
Historical*					
1970	45.7	10.7	6.0	3.3	2.6
1971	47.7	11.9	6.2	3.5	2.7
1972	50.4	12.7	6.6	3.9	2.7
1973	53.7	13.5	7.2	4.5	2.7
1974	56.2	15.4	7.8	5.0	2.8
1975	58.3	16.2	8.0	5.2	2.8
1976	58.1	16.0	8.1	5.4	2.7
1977	61.3	16.9	8.7	5.9	2.8
1978	64.9	18.3	9.1	6.4	2.7
1979E	68.1	19.0	9.8	7.0	2.8
Forecast					
1980	71.7	19.9	10.6	7.7	2.9
1981	75.8	21.0	11.4	8.4	3.0
1982	79.8	22.3	12.1	9.0	3.1
1983	84.0	23.7	12.9	9.7	3.2
1984	87.7	25.0	13.5	10.3	3.2
1985	91.2	26.1	14.2	10.9	3.3
1986	94.5	27.2	14.8	11.4	3.4
1987	97.4	28.2	15.3	11.9	3.4
1988	100.1	29.1	15.8	12.4	3.4
1989	102.6	29.9	16.3	12.8	3.5
1990	104.5	30.6	16.6	13.1	3.5
1991	106.6	31.3	17.0	13.5	3.5

E-Estimate *Source: FAA Air Traffic Activity.
Prior to 1977, the fiscal year ended June 30.
Detail may not add to total due to independent rounding.
Total Flight Services is a weighted workload measurement derived by multiplying pilot briefs and flight plans originated by two and adding the number of aircraft contacted. A flight plan may be filed orally or in writing to qualify for inclusion in the activity count. The data forecast in Tables 24 and 25 are based upon the current number of and configuration of the FSS and CS/T. Any change in their number or operation would have a corresponding change on the forecast.

Table 25
Aircraft Contacted FAA Flight Service Stations and Combined Station/Towers
(in millions)

Fiscal Year	Total	IFR-DVFR	VFR	Air Carrier	Air Taxi	General Aviation	Military
Historical*							
1970	10.0	1.3	8.7	.8	—	8.5	.7
1971	9.9	1.3	8.6	.7	—	8.6	.7
1972	10.0	1.4	8.6	.5	.6	8.8	.7
1973	9.9	1.5	8.4	.6	.7	8.6	.7
1974	9.9	1.5	8.4	.4	.7	8.1	.7
1975	10.0	1.6	8.4	.4	.7	8.1	.7
1976	9.8	1.5	8.3	.4	.8	8.0	.6
1977	10.2	1.7	8.5	.4	.8	8.4	.6
1978	10.2	1.9	8.3	.4	.8	8.4	.5
1979E	10.5	2.0	8.5	.5	1.0	8.5	.5
Forecast							
1980	10.7	2.1	8.6	.5	1.4	8.3	.5
1981	11.0	2.2	8.8	.5	1.5	8.5	.5
1982	11.0	2.2	8.8	.5	1.5	8.5	.5
1983	10.8	2.2	8.6	.5	1.5	8.3	.5
1984	10.7	2.1	8.6	.5	1.4	8.3	.5
1985	10.6	2.1	8.5	.5	1.4	8.2	.5
1986	10.5	2.0	8.5	.5	1.3	8.2	.5
1987	10.4	1.9	8.5	.5	1.2	8.2	.5
1988	10.3	1.8	8.5	.5	1.2	8.2	.4
1989	10.2	1.7	8.5	.5	1.1	8.2	.4
1990	10.1	1.7	8.4	.5	1.0	8.2	.4
1991	10.0	1.7	8.3	.5	1.0	8.1	.4

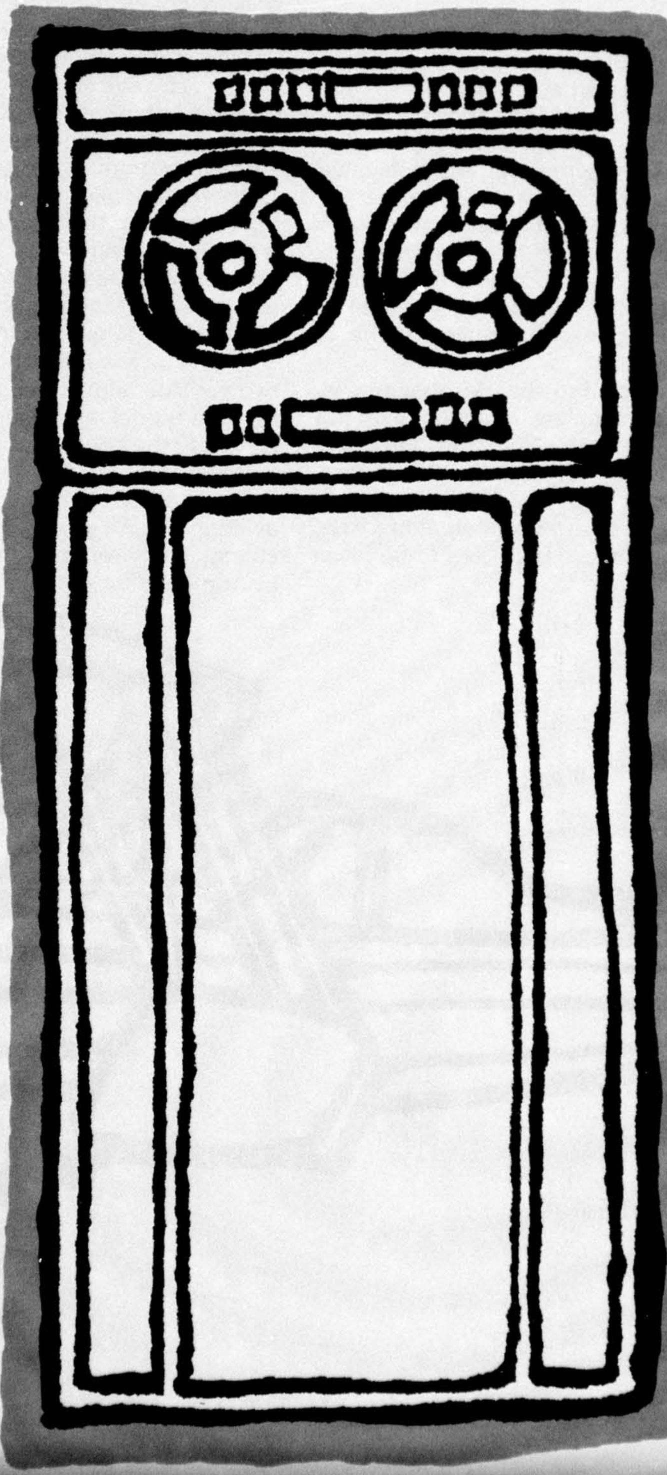
E-Estimate *Source: FAA Air Traffic Activity
Prior to 1977, the fiscal year ended June 30.
Detail may not add to total because of independent rounding.
Aircraft contacted represent a record of the number of aircraft with which FAA facilities (FSS, CS/T) have established radio communications contact. One count is made for each en route landing or departing aircraft contacted by a facility, regardless of the number of contacts with an individual aircraft. A flight involving contacts with five different facilities, disregarding the number of contacts with each, would be counted as five aircraft contacted. Air taxi included with General Aviation prior to 1972.

Table 26
Active Pilots by Type of Certificate
(thousands)

As of January 1	Total	Students	Private	Commercial	Airline Transport	Helicopter	Glider	Other	Instrument Rated(1)
Historical*									
1974	714.6	181.9	298.9	182.4	38.1	6.0	4.3	3.0	186.0
1975	733.7	180.8	305.8	192.4	41.0	5.6	4.8	3.2	199.3
1976	728.2	177.0	305.9	189.3	42.6	4.9	5.3	3.1	204.0
1977	744.2	188.8	309.0	187.8	45.1	4.8	5.8	3.0	211.4
1978	783.9	203.5	327.4	188.8	50.1	4.8	6.2	3.1	226.3
1979E	798.8	204.9	337.6	185.8	55.9	4.9	6.5	3.2	236.3
Forecast									
1980	848.4	208.0	361.1	205.0	58.9	4.9	7.3	3.2	260.0
1981	886.0	212.5	378.6	217.6	61.4	4.8	7.9	3.2	285.0
1982	921.1	219.6	394.0	227.4	63.6	4.8	8.5	3.2	305.0
1983	946.6	223.6	404.2	236.1	65.7	4.8	9.1	3.1	325.0
1984	965.7	224.0	415.2	241.4	67.7	4.7	9.6	3.1	342.5
1985	991.3	226.0	429.4	248.3	69.7	4.7	10.1	3.1	360.0
1986	1016.9	225.0	443.9	258.2	71.6	4.7	10.5	3.0	375.5
1987	1035.5	222.2	454.1	267.2	73.4	4.6	11.0	3.0	395.2
1988	1051.0	217.1	465.3	274.4	75.2	4.6	11.4	3.0	410.7
1989	1067.9	212.2	477.7	281.5	76.9	4.6	12.0	3.0	425.5
1990	1090.7	210.0	492.5	289.6	78.6	4.5	12.5	3.0	440.0
1991	1110.7	210.0	500.0	300.0	80.2	4.5	13.0	3.0	550.0

*Source: FAA Statistical Handbook of Aviation.
Detail may not add to total due to rounding.
[1]Should not be added to other categories in deriving total.
The total count includes all pilots with current medical certificates; it also includes pilots who no longer fly but desire to keep their active status by periodic medical examinations. At the close of 1973 the active pilot count totalled 714,607, compared with 750,869 at the end of 1972. The decrease in the number of airmen resulted from a purging of the Airmen Certification files. During this process approximately 26,000 duplicates of faulty records were eliminated.
Helicopter pilots include pilots who hold only a helicopter certificate.

Appendices



Appendix A

Forecast Comparison

Table A-1 compares the 1979 FAA aviation forecasts with those made in 1978. This section provides explanations for those variations that have developed. Comparisons are made of representative aircraft activity parameters and of FAA workload indicators. Forecasts are compared for three years.

- 1979: To compare the 1978 forecast values with actual preliminary 1979 values for each aviation category.
- 1984: To highlight forecast changes that could affect FAA near-future budgetary actions on manpower, facilities and equipment.
- 1990: To indicate perceived changes in the long-term evolution of aviation activity.

Aviation Activity. The air carrier forecasts have changed since last year because of an increase in the number of carriers being considered. However, in comparing growth rates it can be seen that air carrier passenger activity is now forecast to grow more rapidly than predicted last year, due basically to increased personal flying as a result of discount options introduced by the airlines.

Air cargo is now expected to show stronger gains, due primarily to the effects of complete deregulation of the air cargo industry that has increased the number of markets receiving cargo service. The 1979 forecast for the general aviation fleet is slightly lower for 1984 and 1990, but overall the forecast remains basically consistent with that of 1978. Hours flown by general aviation are predicted to be lower than the forecast of hours flown made in 1978, due primarily to the impact of higher fuel costs on general aviation local flying and to statistical adjustments in the historical and base year information. Forecasts of military aviation fleet size are slightly higher than in 1978. Military hours flown are expected to be slightly lower.

FAA Workload Measures. As indicated in Table A-1, the forecasts of FAA workload measures in the September 1979 publication differ slightly from those presented in the September 1978 forecasts. The preliminary estimates for aircraft operations in 1979 are lower than that forecast in 1978 primarily because of a decline in general aviation local operations.

The current forecasts of aircraft operations at FAA towered airports and IFR aircraft handled at Air Route Traffic Control Centers in 1990 are not significantly different from the forecasts made in September, 1978. However, the mid-term forecasts for both instrument operations and flight services are changed substantially, as is the long-term forecast for flight services. The instrument operations forecast reflects the increased use of avionics, especially by general aviation aircraft. This increase in use represents a long-term trend.

The lowered forecast for flight services results from two considerations. The historical data in the general aviation model was adjusted downward for some years to eliminate the count of flight services provided by international flight service stations. At the same time, the potential future demand for flight services by general aviation aircraft pilots was reevaluated in the light of a changing environment that includes increased instrumentation and higher fuel costs.

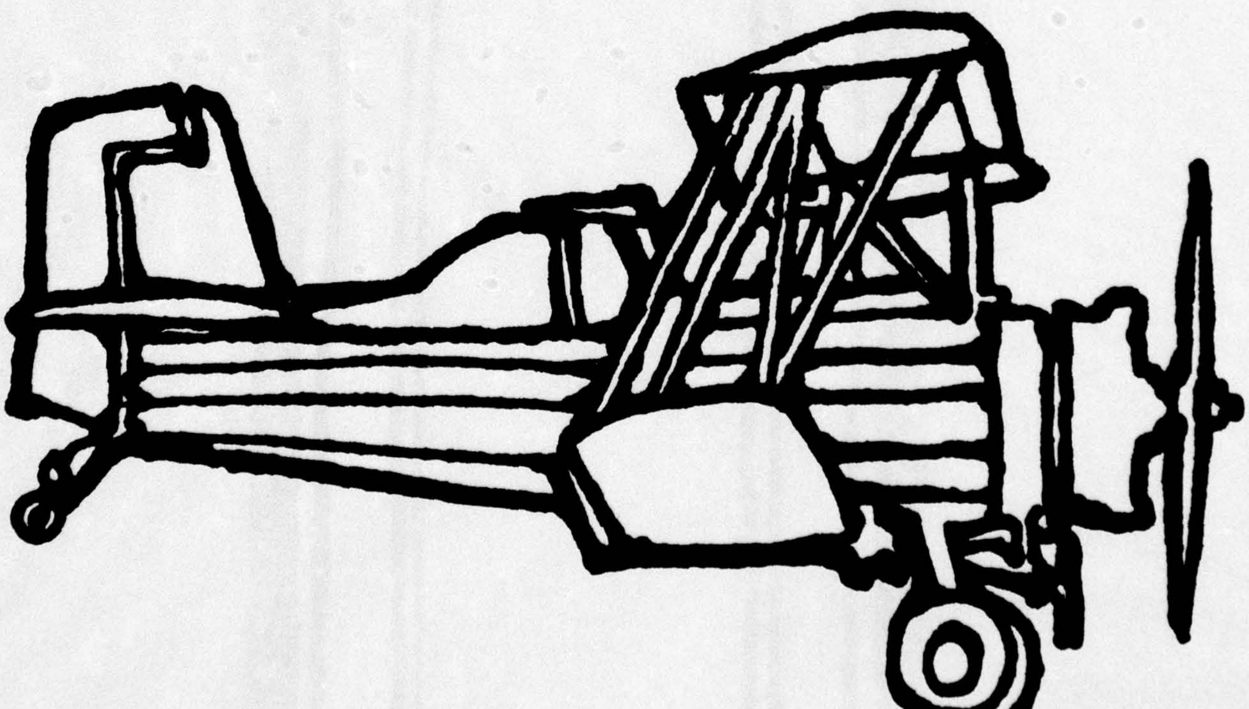


Table A-1
Forecast Comparisons

(September 1979 versus September 1978)

Aviation Activity Forecasts

Air Carriers

Year/Forecast	Enplanements (millions) 1978	1979[1]	Percent Change	Revenue Passenger Miles (billions) 1978	1979	Percent Change
1979	287.3	317.7*	+10.6	233.7	256.1*	+9.6
1984	356.8	409.0	+14.6	298.4	336.5	+12.8
1990	453.9	523.1	+15.3	394.1	439.8	+11.6

General Aviation

Year/Forecast	Total Aircraft (thousands) 1978	1979	Percent Change	Hours Flown (millions) 1978	1979	Percent Change
1979	198.8	193.0*	−2.9	41.4	39.0	−5.8
1984	251.1	247.9	−1.3	53.6	50.5	−5.8
1990	310.8	297.2	−4.4	67.4	62.1	−7.9

Military Aviation

Year/Forecast	Total Aircraft 1978	1979	Percent Change	Hours Flown (thousands) 1978	1979	Percent Change
1979	18,527	18,623*	+0.5	5,694	5,090	−10.6
1984	18,709	19,562	+4.6	5,691	5,220	−8.3
1990	18,721	19,531	+4.3	5,697	5,286	−7.2

Air Cargo

Year/Forecast	Revenue Cargo Tons (thousands) 1978	1979	Percent Change	Revenue Cargo Ton Miles (millions) 1978	1979	Percent Change
1979	5,272	5,201*	−1.4	12,685	13,010	+2.6
1984	6,831	7,237	+5.9	17,882	20,186	+12.9
1990	9,380	10,435	+11.3	27,856	32,042	+15.0

FAA Workload Measures

Aircraft Operations (millions)

Year/Forecast	1978	1979	Percent Change
1979	71.3	70.6*	−1.0
1984	88.6	86.4	−2.5
1990	100.2	98.7	−1.5

Instrument Operations (millions)

Year/Forecast	1978	1979	Percent Change
1979	34.4	34.8*	+1.2
1984	41.5	45.5	+9.4
1990	52.0	54.6	+5.0

IFR Aircraft Handled (millions)

Year/Forecast	1978	1979	Percent Change
1979	29.7	29.2*	−1.7
1984	36.9	36.1	−2.2
1990	45.6	43.0	−6.0

Flight Services (millions)

Year/Forecast	1978	1979	Percent Change
1979	72.9	68.1*	−6.6
1984	105.4	87.7	−16.8
1990	134.5	104.5	−22.3

*Preliminary Estimates

(1)Introduces scheduled passenger traffic, principally intrastate air carrier traffic, not previously reported to the Civil Aeronautics Board.

Appendix B

Aviation Forecasting for Large Hubs

The forecasting of aviation activity at the 25 largest "hubs" in the United States is a key element of the Federal Aviation Administration's (FAA) Forecasting Initiative. They are developed as a part of the forecasting program conducted by the FAA's Aviation Forecast Branch, Office of Aviation Policy to serve the budgetary and planning needs of the FAA. Individual hub forecasts either have been published or are in development for those regional hubs where at least one percent of the National total of enplaned revenue passengers was boarded by certificated route air carriers.

Regional Forecasting. The hub forecasts serve a dual purpose. They were undertaken originally to meet the need for more detailed Federal forecasts of aviation activity not only at principal air carrier airports but also at the surrounding smaller airports. This regional approach to forecasting makes the forecast useful in evaluation of the need for additional airport capacity, the determination of assignments for new air traffic control facilities, and regional airspace capacity studies. Since ownership and development of new airports are primarily a local, regional and state responsibility, these forecasts address more than just a Federal need.

The hub forecasts are disaggregated from National aviation forecasts and cover all the air carrier and general aviation airports open for public use in a given region. These facilities include both publicly and privately owned airports. Their derivation from the National forecast permits coordinated policy evaluation, planning and management at the local as well as Federal levels.

General aviation is a beneficiary of this approach since general aviation activity, when measured in terms of operations, accounts for over 75 percent of all aviation activity in the United States. This traffic may use the shorter runways found at most secondary and satellite airports. Local, regional and state transportation and aviation policies directly effect the distribution of this traffic within the region.

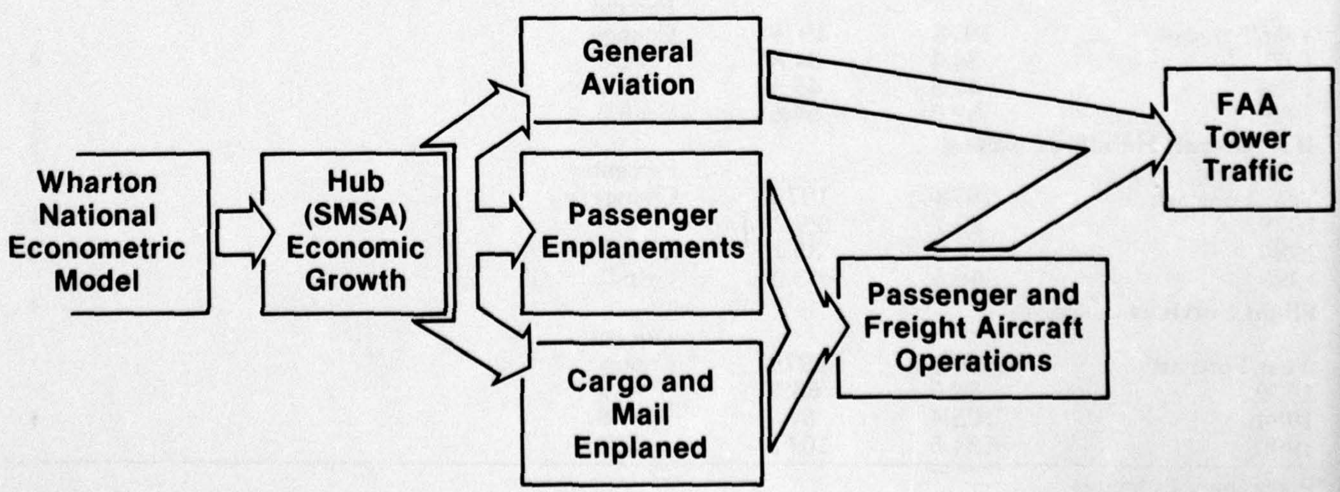
Forecast Evaluation and Coordination. The process used in creating the hub forecasts rests on a foundation of communications with concerned individuals and agencies in the hub region. It is a melding of Federal and localized forecasting capability based on Federal data collection and local insight into the special situations and opportunities present in the hub. The product of this interaction is a series of forecasts for:

- General aviation operations by airports
- Passenger enplanements by type of service and airport
- Cargo and mail enplanements by type of service
- Passenger and cargo aircraft operations by airport and type of service
- Traffic handled by FAA towers by location and type of service
- Traffic handled by all non-towered airports, whether public or privately owned, which are available for public use.

The interaction that results in the hub forecasts consists of multiple individual consultations among Federal and local officials. Additionally, seminars often are held so that the specific issues surrounding aviation within a hub may be discussed and analyzed. Representatives of government, industry, local service providers, aviation users, and the concerned public are invited to attend these seminars.

These consultations are designed to benefit aviation in general by providing feedback to the FAA which is then used to improve the assumptions and data employed in the forecasts. The hub forecasts are developed from assumptions and data similar to that used in the National forecasts. Changes in the individual hub forecasts recommended through this consultation process are employed to improve the hub forecast under discussion and to sharpen the hub forecasting process in general.

Figure B-1
Hub Forecast Overview



Furthermore, the sum of feedback on the hub forecasts is translated into improvements in the National forecast for the following year.

At the local level, these consultations—particularly the hub seminars—provide a forum at which all concerned members of the community have an opportunity to interact and contribute to the planning process within their community. As aviation activity grows to the point where capacity and access problems must be resolved—as it already has in several hubs—these contributions become a significant input to the planning for reliever and new airport development.

The Hub Forecasting Process

The hub forecasts are policy development tools for use within discrete geographical boundaries. The boundaries usually taken are the Standard Metropolitan Statistical Area (SMSA) or areas for a region served by an air carrier airport enplaning a minimum of one percent of the total passenger enplanements in the United States.

The hub forecasts are developed through a combination of "top-down" and "bottom-up" approaches. However, the assumptions used and the data generated by this process, in aggregate for all hubs, must be consistent with the National forecast.

Figure B-1 indicates the econometric basis used in developing the individual hub forecasts. Wharton Econometric Forecasting Associates data are reconciled with local economic forecasts from the U.S. Department of Commerce to serve as the foundation for the aviation forecast.

General Aviation Operations. Micro forecasts for the various aviation segments are developed employing localized socioeconomic growth projections. For example, the forecast of general aviation operations within a hub is based on a reconciliation of the Wharton and Commerce Department's economic forecast for the region. To these projections are brought the National general aviation forecast and historical data obtained for all airports within the hub. From this data, general aviation operations are predicted for all FAA towered airports and all other hub airports (see Figure B-2).

The historical data for general aviation operations are taken from *FAA Air Traffic Activity*, prepared by the FAA Office of Managment Systems. This information is published annually.

Local and itinerant general aviation forecasts are based on a model of operations for the time interval 1959-1974. This model was developed originally to forecast National general aviation activity and has been modified to suit the individual hubs. General aviation activity is regressed against values for personal income and National defense expenditures in constant 1972 dollars. The resulting coefficients and projections of the economic variables are then used to obtain local and itinerant operations. More localized economic data from within the SMSAs are employed to generate forecasts for individual FAA towered airports and non-towered airports.

Passenger Enplanements. A similar logic is applied in developing forecasts for the other aviation measures that become a part of the hub forecast. Figure B-3 details the process employed to obtain a forecast of passenger enplanements. National passenger enplanement projections are disaggregated using hub market share estimates. This information is adjusted in light of recent local experience. Throughout the process, balancing checks are conducted to ensure that this melding of bottom-up and top-down approaches remains consistent with the overall National forecast. The product of this model is a projection of airport passenger enplanements by service type and location.

A full description of this method and the data that were used are contained in a four-volume report prepared

Figure B-2
General Aviation Methodology

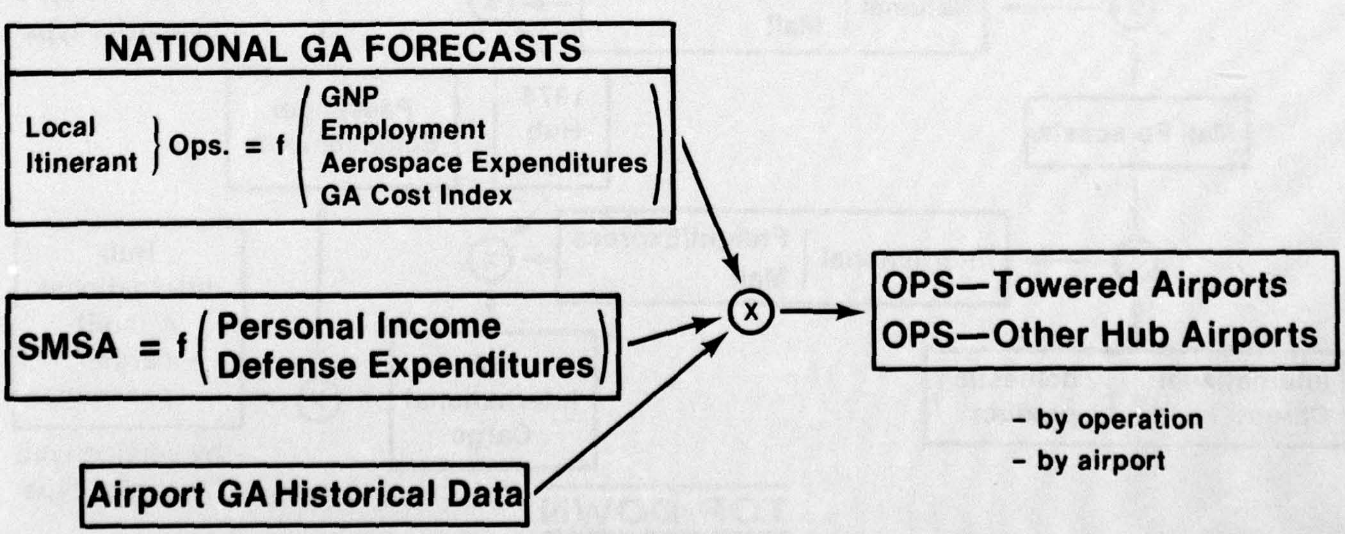


Figure B-3
Enplanements Methodology

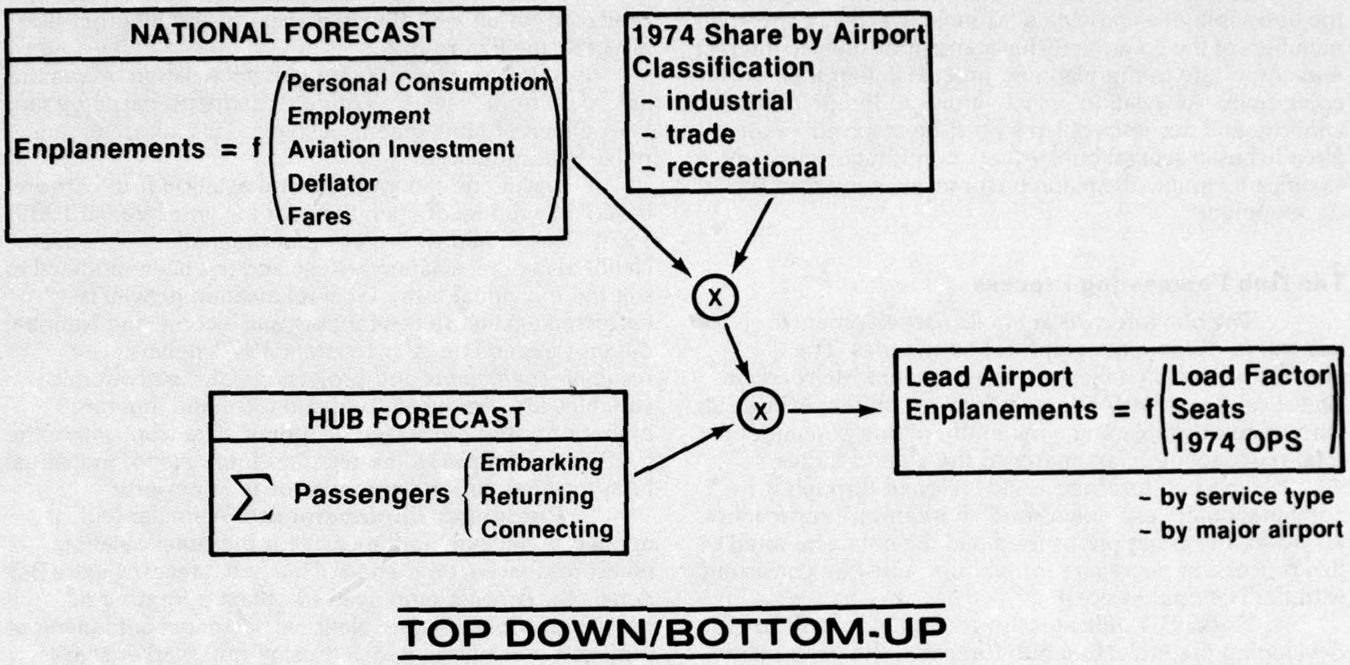
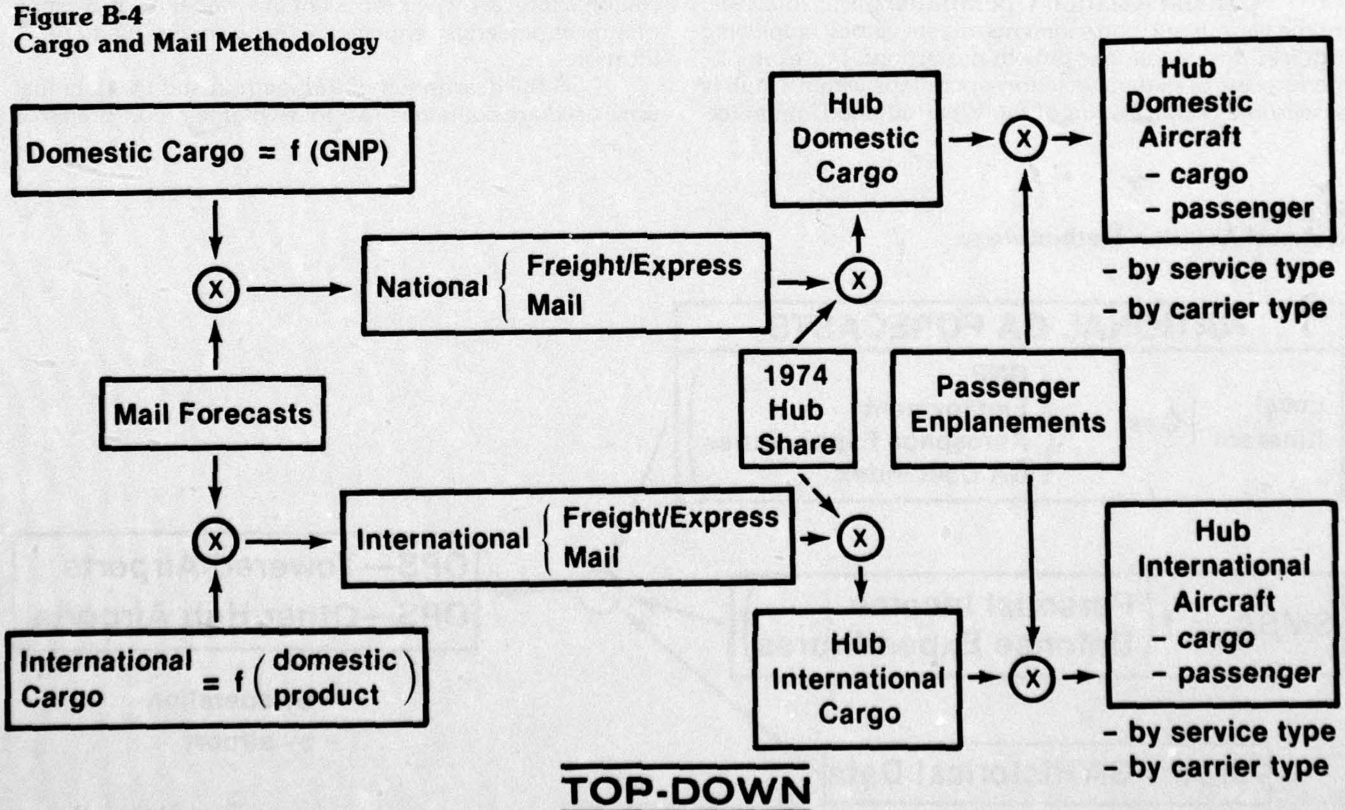


Figure B-4
Cargo and Mail Methodology



by Systems Analysis and Research Corporation under contract DOT-TSC-1182 for the Transportation Systems Center.

Air Cargo. Air cargo forecasts are developed employing the top-down approach. As in passenger enplanements, the 1974 market share percentages are used as a basis for disaggregating the National forecast to the hub. Since much cargo—and virtually all international cargo—is carried in the lower holds of passenger aircraft, passenger enplanement projections are used as a measure of air cargo capacity to be factored into the forecast. The products of the cargo model are domestic and international projections by service and carrier types (see Figure B-4).

Forecasting Models for Air Freight Demand and Projection of Cargo Activity at U.S. Hubs provides a more specific discussion of forecasting U.S. domestic and U.S. international air freight demand in the United States and the large hubs. The report, prepared by the Transportation Systems Center for the FAA, documents an econometric approach to long-term National air freight demand forecasting. The report is available from the Office of Aviation Policy, Federal Aviation Administration, 800 Independence Avenue, S.W. Washington, D.C. 20591.

Operations. Translation of passenger and cargo ton enplanements into commercial traffic operations is detailed in Figure B-5. National projections of aircraft in use, their expected load-factors, and industry expert judgement of types of service are used to yield a projected total for passenger and freight operations.

So far in the process, constraints to airport capacity and access have not been considered. However, realistic forecasting requires that present and expected constraints be factored into the hub forecasts. There are few hubs where constraints are not expected to influence airport capacity at some time in the next decade. Local policy decisions on land-use surrounding airports and the constraints imposed by ground access to airports are some of the factors considered in predicting a future airport operational limitation. Any constraint likely to affect future aviation is considered and acted upon as a result of consultations at the hub.

When these constraints are applied to projected operations, the result often is that some of the projected traffic must be diverted to other airports within the hub (see Figure B-6). If applied to a given hub forecast, these projected diversions are clearly stated and well documented.

Consultation Process. The hub forecasts are developed by FAA staff in Washington, D.C., employing the services of expert consultants. An initial draft of a hub forecast is sent out for review by FAA Regional staff. Their comments and suggestions are incorporated prior to a review cycle that includes the communities affected by the forecast. At this level, airport operators, local and regional planning authorities, the aviation community including both commercial and general aviation interests, and concerned

Figure B-5
Aircraft Operations Methodology

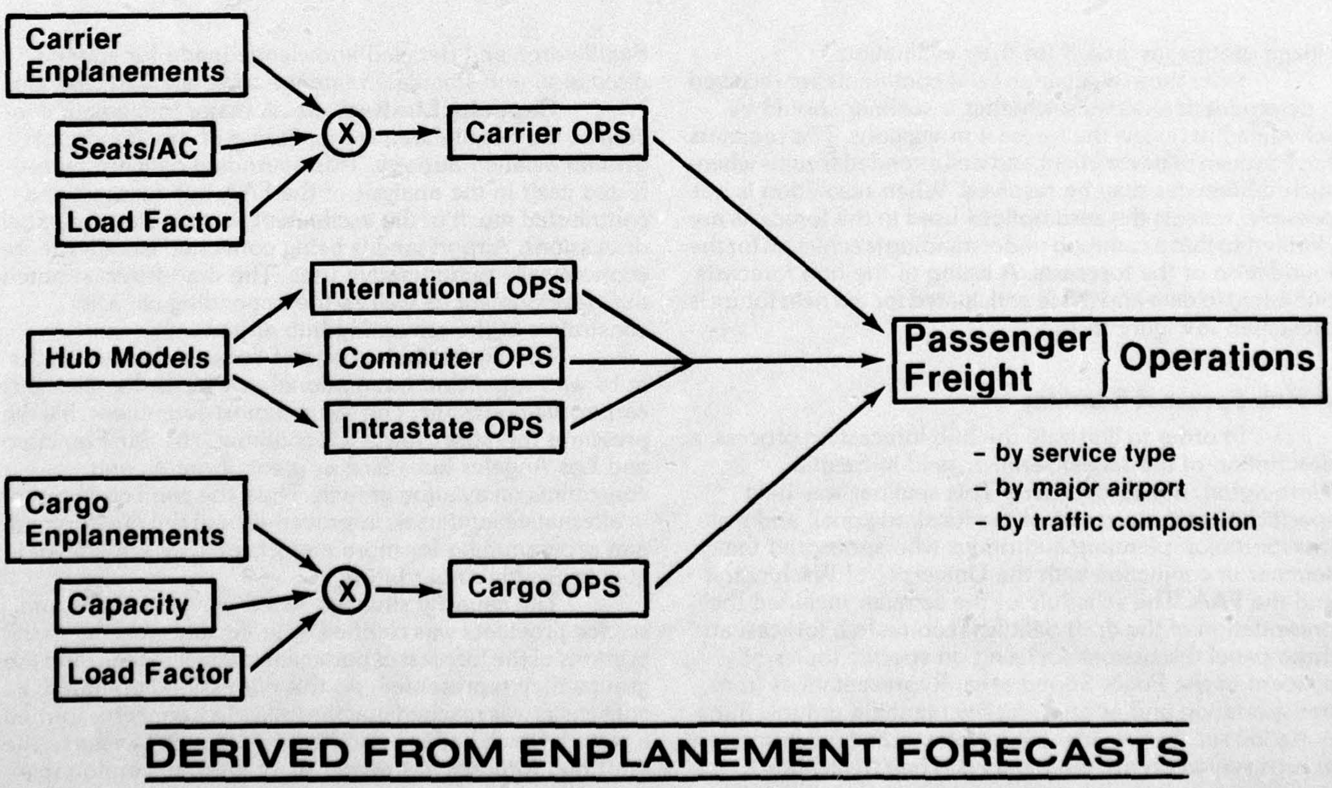
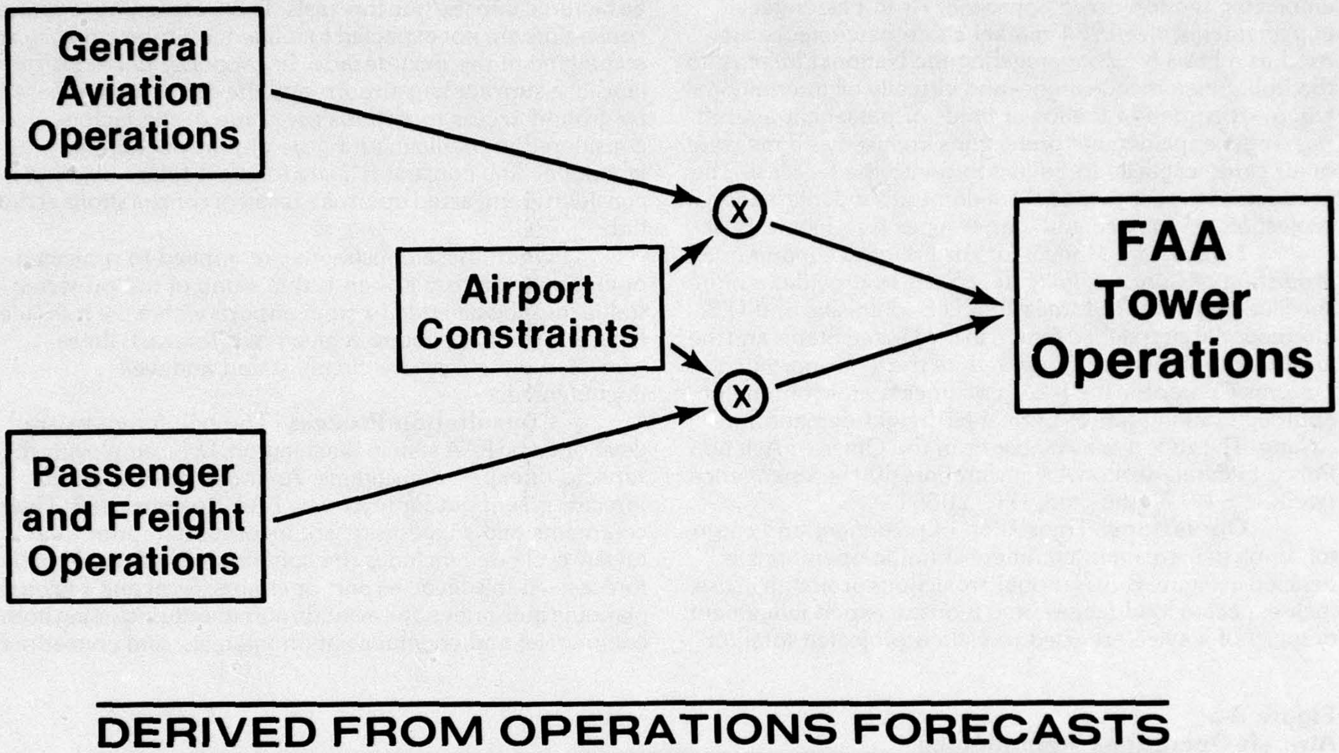


Figure B-6
FAA Tower Traffic Methodology



citizen groups are asked for their evaluation.

After these evaluations and comments are received a determination is made whether a seminar should be scheduled to review the forecast projections. The seminars have proven to be excellent and well attended forums where such differences may be resolved. When resolution is not possible, at least the assumptions used in the forecasts are clarified so that a common understanding is achieved for the foundation of the forecasts. A listing of the hub forecasts published to date and those anticipated for the near future is presented in Figure B-7.

A Hub Forecast Seminar

In order to illustrate the hub forecasting process, a description of the recent seminar held in Seattle, Washington is included here. This seminar was held specifically at the request of the local, regional, and state transportation planning authorities who sponsored the seminar in conjuction with the University of Washington and the FAA. The schedule of the seminar included the presentation of the draft Seattle/Tacoma hub forecast and three panel discussions focusing on specific topics of concern in the Puget Sound area. Representatives from transportation and aviation facility planning groups, transportation service provider organizations, and public interest groups served on the three panels. Their dedication to the Seattle area and detailed knowledge made for spirited discussion and stimulated intense audience participation.

Capacity Limitations. A major immediate concern in the Seattle area is the closing of two important general aviation airports. This overriding concern manifested itself in the analysis of the FAA hub forecast and contributed much of the excitement surrounding the panel discussions. Airport land is being converted to other more economically remunerative uses. The draft forecast noted this development as well as the impending capacity constraints at the remaining hub airports.

The Seattle hub is one of three major west coast hubs with significant international as well as domestic air carrier aviation traffic. This status almost guarantees that the pressures for more growth will continue. The San Francisco and Los Angeles hubs face as great, if not greater, constraints on aviation growth. Thus, the conflicts inherent in alternative land uses, improvements of the environment and programming for more airport capacity are unavoidable in Seattle's near future.

The capacity situation faced by user groups and service providers was clarified as individuals reacted to the portions of the forecast of particular interest to them and the groups they represented. As this discussion continued, a consensus was reached that the individual concerns formed a pattern which had to be addressed as a unit. In a sense, the draft hub forecast was bearer of, at least, uncomfortable

news. Participants at the seminar agreed that the hub capacity problems had to be confronted from the perspective of the entire region. Unilateral action on the part of individual segments of the community would not be as effective in fostering desirable growth.

Forecast Accuracy. Another issue raised at the day-long session was confidence in forecast accuracy at a time when economic projections are surrounded with as much uncertainty as exists in the present. The effects of fuel shortages and rapidly escalating prices were discussed as an important contributor to this uncertainty. Needless to say, immediate answers to such questions were not easily produced. The FAA is investigating the effects of economic uncertainty on the forecasts as part of a larger study of forecast accuracy.

Given these uncertainties, stress was placed on the importance of the relationship between forecast assumptions and activity projections. The "numbers" of the forecast rest on a foundation of assumptions. If the assumptions made of the future do not correspond with the events of that future, then the numbers also are unlikely to correspond to actual activity. Thus, the best immediate answer to the issue of uncertainty that could be given was—and is—that the forecasts have to be applied with knowledge of their assumptions and a measure of caution.

Figure B-7
Hub Forecast Publication Status

Hub	Final Publication
Los Angeles	6/78
Houston	6/78
Atlanta	8/78
Dallas-Ft. Worth	11/78
Miami-Ft. Lauderdale	11/78
Chicago	3/79
Tampa	7/79
Philadelphia	8/79
Denver	8/79
Seattle	9/79
Cleveland	9/79
Kansas City	9/79
San Francisco	10/79
Detroit	10/79
St. Louis	10/79
Honolulu	11/79
Pittsburgh	11/79
Boston	
Phoenix	
Minneapolis	
Las Vegas	
Portland	
Memphis	
Washington-Baltimore	
New York-Newark	

Additional hubs under consideration: New Orleans, Anchorage, San Juan.

Summary. For the FAA, the hub seminars represent a means of rapidly assessing the quality of forecast inputs and projections with the help of a cross-section of the community involved. The final publication of the hub forecasts often is improved as a direct result of the interaction made possible by the seminars. Since the hub forecasts are based on the current National forecast, another benefit is insight that can be applied in the following year's National forecast.

The contribution of the seminar to the local community typically extends considerably beyond the clarification of the hub forecast. In some communities, the hub seminar has been the first opportunity for many community representatives to interact on the topic of future aviation. The benefits to local aviation of the contacts established at these sessions should become evident as local planning and management of aviation takes on a broader, more community based, perspective. The attendance and participation of political, industrial, and social community leaders at the seminars encourages the belief that this broadening of perspective will occur.

The forecasting of aviation activity into the future poses many questions which will have to be answered by the forecast users. The issue of airport capacity is an obvious one. The seminars provide an early discussion forum from which solutions, in time, may derive. This is a very important function of the seminars. American aviation is owned and operated by private and quasi-public agencies and municipal, regional, and state governments. The Federal government has a relatively small ownership and management role. So, while the solutions to issues such as capacity may be facilitated with Federal resources, solutions will be achieved by and within the affected communities.

Appendix C

The Air Cargo Forecasting Model*

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Introduction

This paper presents the major results of a staff study completed at the Department of Transportation, Transportation Systems Center (TSC) in FY 1979. This study had three main objectives. First, econometric models for domestic and international air cargo activity, both freight and express (excluding mail), were empirically constructed and estimated. Second, annual forecasts for 1979-1991 were generated from these estimated models. Third, aggregate domestic and international air cargo activity forecasts were disaggregated into air cargo activity forecasts at selected major air hubs.

The new TSC air cargo econometric model consists of two major sub-models: the domestic air cargo model and the international air cargo model.

The domestic air cargo (freight plus express) model is composed of three components: 1) passenger/cargo carrier, all services, 2) all cargo carrier, scheduled services, and 3) all cargo carrier, non-scheduled services.

The international air cargo model consists of six world regional models. These six world regions are: North America excluding U.S., South America, Europe, Asia, Australia and Oceania, and Africa. For each world region, export (outbound) and import (inbound) equations of U.S. flag carriers and total carriers are constructed and estimated. In total, there were 24 regression equations in the international air cargo model.

A common practice in previous empirical studies of air cargo demand was to choose between linear forms and log-linear forms. In this study, Box-Cox transformation techniques were adopted to provide guidelines for choosing alternative functional forms for air cargo demand. The linear and log-linear forms are special cases of this class of transformation. The levels of long-run forecasts critically depend on the functional form chosen by the model builders. Empirical results of these models can be used as a basis on which to evaluate the impact of changes in certain macroeconomic variables on the behavior of air cargo activity. Alternative annual forecasts from 1979 to 1991 were generated from the new TSC air cargo model with alternative scenarios of future values of gross national product (GNP) in 1972 dollars and real yield per revenue ton-mile. A top-down approach was employed to produce the forecasts of domestic air cargo activity for each of the top 38 air hubs and the forecasts of international air cargo activity for each of the 28 major air hubs. These forecasts not only will provide valuable information for FAA budget and policy plan development but also information required by local and regional planners for hub airport facilities.

The organization of this paper is composed of two sections: the domestic air cargo model and forecasts are presented next; the international air cargo model and forecasts follow.

*This is a summary of a larger report prepared by the authors at TSC under contract to the FAA.

Domestic Air Cargo Model

In this section, the domestic air cargo model, the empirical results and the forecasting assumptions used to produce the forecasts are discussed.

The Models: In general, demand for air freight is a function of general economic activity, air freight rates, and the quality of air freight service. The quality of freight service includes: 1) schedule frequency, 2) speed, 3) capacity, 4) reliability of delivery time, and 5) probability of loss and damage. Unfortunately, there was no comprehensive and consistent set of data available on the quality of freight service. As a result, quality of service variables were not included in this model.

The domestic air freight industry is composed of two sub-industries: passenger/cargo carriers and all cargo carriers. The bulk of cargo capacity offered by the passenger/cargo carriers is in the lower holds of passenger flights. These flights follow route patterns and schedules which are optimized to meet the needs of passenger travel patterns. They do not necesarily meet the needs of freight shippers. For example, very often shippers of freight tend to make up shipments during the day and release them to carriers in the late afternoon and evening for carriage that night. However, the schedule of passenger flights is heavily concentrated during the day. All cargo carriers, in general, are more flexible in meeting the route pattern and schedule demanded by freight shippers. Therefore, the freight services offered by these two groups are non-homogeneous in terms of route patterns, schedules and capacity offered by aircraft. Thus, disaggregate demand models for these two groups were constructed and estimated in order to capture these differences in the quality of freight services.

The initial statistical models for passenger/cargo carriers and all cargo carriers are:

$$Y_{1t}^{(\lambda)} = a_0 + a_1 X_{1t}^{(\lambda)} + a_2 X_{3t}^{(\lambda)} + a_3 X_{5t} + e_{1t} \quad (1)$$

$$Y_{2t}^{(\lambda)} = \delta_0 + \delta_1 X_{1t}^{(\lambda)} + \delta_2 X_{4t}^{(\lambda)} + \delta_3 X_{5t}^{(\lambda)} + e_{2t} \quad (2)$$

where

Y_{1t} = cargo (freight plus express) revenue ton-miles of passenger/cargo carriers, all services

Y_{2t} = cargo (freight plus express) revenue ton-miles of all cargo carriers, scheduled services

X_{1t} = GNP in 1972 dollars

X_{3t} = the real yield per revenue ton-mile of passenger/cargo carriers, all services

X_{4t} = the real yield per revenue ton-mile of all cargo carriers, scheduled services

X_{5t} = current yield per ton-mile of Class I motor carriers, deflated by GNP implicit price deflator (1972 = 100). It should be mentioned that this variable was used as a proxy for the price index of revenue ton-mile of Class I motor carriers because the data of current yield per revenue ton-mile was not available at the time this study was undertaken.

and e_{1t} and e_{2t} are error terms, which are assumed to be distributed as $e_{1t} \sim NID(0, \sigma^2_{e1})$ and $e_{2t} \sim NID(0, \sigma^2_{e2})$ respectively.

In equations (1) and (2), Box-Cox transformation techniques were used to help choose a flexible functional form for the passenger/cargo carrier model and the all cargo carrier model. The Box-Cox transformation for the variable $Y_{1t}^{(\lambda)}$ and $X_{1t}^{(\lambda)}$ are defined as:

$$Y_{1t}^{(\lambda)} = \begin{cases} \frac{Y_{1t-1}}{(\lambda)} & \text{when } (\lambda) \neq 0 \\ 1nY_t & (\lambda) = 0, \end{cases} \quad (3)$$

$$X_{1t}^{(\lambda)} = \begin{cases} \frac{X_{1t-1}^{(\lambda)}}{(\lambda)} & \text{when } (\lambda) \neq 0 \\ 1nX_t & (\lambda) = 0. \end{cases} \quad (3)$$

A similar definition is used for the rest of the variables $Y_{2t}^{(\lambda)}$, $X_{it}^{(\lambda)}$ $i = 2, 3, 4, 5$. For example, clearly when $\lambda = 1$, equation (1) becomes linear and when $\lambda = 0$, the equation becomes linear in log form. It is apparent that different values of λ lead to different functional forms. The main advantages of the Box-Cox techniques are achievement of: nearer-normality of error terms; homogeneity of variance of error terms; an additive model; in this case, a transformation that is the result of estimation, not prior specification; and lastly, to provide a test procedure to compare alternative functional forms rather than to accept a particular functional form as a maintained hypothesis.

Finally, some limitations in the application of these techniques should be mentioned. The Box-Cox techniques fail to provide guidance in selecting alternative functional forms if the likelihood function of (λ) is very flat: this situation, however, was not encountered in this study. The distribution properties of this test are derived from large sample theory. Therefore, the application of this test to the small sample situation should be interpreted with care.

The approach in choosing the appropriate functional form is based on the results obtained from Box-Cox techniques and also prior knowledge about the future possible behavior of air cargo traffic.

The Empirical Results. The estimated disaggregate demand models for domestic air cargo traffic are presented in this section. In estimation of the parameters of the models, each variable was first transformed, following the definition of $Y_t^{(\lambda)}$ and $X_{it}^{(\lambda)}$ in equation (3). The value of λ is specified in the range of $[-1.6, 1.6]$ with increment intervals of 0.2. Then the least square estimation was performed on each set of transformed variables. The estimation model chosen is the one which maximize the log likelihood function of λ.

The empirical results of the passenger/cargo carrier models are presented in Table C-1. It is interesting to observe that the coefficient of motor freight price is positive and statistically significant at the 5% level in the time period from 1950 to 1977. However, the t-statistic of this variable becomes 1.38 in the model from 1955 to 1977 and decreases to 1.12 in the model from 1960 to 1977.

The model of all cargo carriers, scheduled services, specified in equation (2) was first estimated with three time periods similar to those of the passenger/cargo model. The motor freight price variable was insignificant in all three models. Thus, this variable is deleted from the revised model.

The equation for all cargo carriers, scheduled services, estimated with time series data from 1962 to 1977 is reported in equation (9), Table C-2. The dynamic model is preferred over the static model with first-order autocorrelated errors in this case. Both the GNP and real price variables possess correct signs but the latter variable is not significant in the equation.

The regression results of all cargo carriers, non-scheduled services, are very disappointing. The non-scheduled series fluctuates widely over this sample period, indicating that the random component of the series dominates the systematic part of the series. For forecasting purposes, non-scheduled services are treated as 3.3% of the scheduled services of all cargo carriers.

After completion of the empirical study, 1978 air cargo data became available. In order to incorporate the updated information, equation (7) of the passenger/cargo carrier model and equation (9) of the all cargo carrier model were re-estimated.

A dummy variable X_{6t} is adopted to take account of the deregulation effects on all air cargo carriers, scheduled services. The updated passenger/cargo and all cargo model are presented in equation (8) of Table C-1 and equation (10) of Table C-2.

In summary, Box-Cox transformation techniques are used to choose the flexible functional form for the air cargo models. In the passenger/cargo model, the maximum likelihood estimation of λ is 0.4. The hypothesis that the functional form is linear or logarithmic is rejected in the sample period. This provides empirical evidence that conventional specification of either linear or logarithmic form is not flexible enough for correct functional specification.

In the period from 1962 to 1978, the empirical estimate of λ is 0 which supports the specification of logarithmic functional form for the all-cargo carrier model.

Forecasting. The forecasting procedure consists of two steps: extrapolation of independent variables under varying assumptions and the substitution of these extrapolated variables into the estimated demand equations. The forecasts implicitly assume that the basic structural relationships among the variables for the 1962-1978 period will remain unchanged through 1991.

The future values of real yield per revenue ton-mile for domestic passenger/cargo carriers and all-cargo carriers are respectively projected through three alternative growth rates. It is anticipated that these alternative growth rates will bracket the range of probable real values.

Under the increasing air cargo price scenario, the real yield per revenue ton-mile for passenger/cargo carriers and all cargo carriers are assumed to increase two percent annually. Under the constant air cargo price scenario, the real yield per revenue ton-mile for both types of carriers are assumed to remain constant at their 1978 levels throughout the forecasting period. Under the declining air cargo price scenario which utilizes historical 1962 to 1978 average annual growth rates, the real yield per revenue ton-mile is assumed to decline 1.1 percent annually for passenger/cargo carriers and 0.4 percent annually for all cargo carriers, scheduled services.

Two alternative forecasts of GNP in 1972 dollars from 1979 through 1991 are obtained from forecasts produced from Wharton EFA's annual model. The first set

Table C-1
The Estimated Passenger/Cargo Carrier Models*

Equation Number	Time Period	$\hat{(\lambda)}$	L-max	Constant	$X_{1t}^{(\lambda)}$	$X_{3t}^{(\lambda)}$	$X_{5t}^{(\lambda)}$	D-W	R^2
(4)	1950-1977	0.2	−109.70	0.887	2.15	−4.87	2.24	1.67	0.99
				(0.14)	(10.04)	(−8.22)	(2.06)		
(5)	1955-1977	0.2	−100.33	−2.44	2.33	−5.00	2.52	1.42	0.99
				(0.16)	(4.61)	(−4.60)	(1.38)		
(6)	1960-1977	0.2	−81.97	5.92	2.00	−5.38	2.09	1.82	0.99
				(0.41)	(4.07)	(−5.65)	(1.12)		
(7)	1962-1977	0.2	−75.68	5.28	2.03	−5.54	2.39	1.88	0.98
				(0.33)	(3.77)	(−5.33)	(1.14)		
(8)	1962-1977	0.4	−75.71	54.96	1.81	−11.5	—	1.69	0.98
				(1.89)	(4.77)	(−5.54)			
	1962-1978	0.4	−81.52	12.59	2.42	−8.69	—	1.14	0.98
				(0.68)	(10.56)	(−5.63)			

*The numbers in parentheses are the associated t-statistics of the coefficients

Table C-2
The Estimated All Cargo Carrier Models*
(scheduled services)

Equation Number	Time Period	$\hat{(\lambda)}$	L-max	Constant	$X_{1t}^{(\lambda)}$	$X_{4t}^{(\lambda)}$	$Y_{2t-}^{(\lambda)}$	$X_{6t}^{(\lambda)}$	D-W	R^2
(9)	1962-1977	0	−52.91	−5.68	1.39	−0.42	0.50		1.29	0.95
				(−1.03)	(1.76)	(−0.65)	(2.48)			
(10)	1962-1978	0	−57.1	−7.09	1.59	−0.36	0.47	0.44	1.21	0.97
				(−1.46)	(2.12)	(−0.69)	(2.39)	(2.81)		

X_{6t} = Dummy variable denotes one for the year 1978 and zero otherwise
This variable is used to take account of deregulation effect on all cargo carriers, scheduled services.
*The numbers in parentheses are the associated t-statistics of the coefficients

of real GNP forecasts is obtained from the post-meeting control solution of Wharton's annual model. The average growth rate of GNP in 1972 dollars from 1979 to 1991 is 2.9% annually. The second set of real GNP forecasts is obtained from the solution of Wharton's annual model under the assumption of higher productivity. Under this assumption, the corresponding average growth rate for the same period is 3.2 percent annually.

Using the forecasting assumptions mentioned above, alternative annual forecasts (1979 to 1991) of passenger/cargo carrier are generated from equation (8) and the forecasts of all cargo carrier, scheduled services, are calculated from equation (9). Total domestic air cargo traffic (freight plus express) forecasts are the sum of the forecasts of passenger/cargo carriers and all cargo carriers, scheduled services and non-scheduled services. The forecasts of non-scheduled all cargo carriers are assumed to comprise 3.3% of the forecast value obtained for all air cargo carriers, scheduled services, in each forecasting period. Table C-3 presents total domestic air cargo traffic (freight plus express) forecasts and the forecasting assumptions about the corresponding independent variables in the models. The displays of the forecasts are shown in Figure C-1.

Domestic average length of haul distances for passenger/cargo and all cargo carriers respectively were computed by dividing aggregate revenue ton-miles flown in domestic freight and express service by their corresponding enplaned tonnage statistics.

All cargo carriers participate primarily in the high volume, long-haul air cargo market. Consequently, the domestic average haul for all cargo carriers exceeds the domestic average haul for passenger/cargo carriers. In 1978, the domestic air cargo average length of haul for all cargo carriers was 1,680 miles whereas the average domestic haul for passenger/cargo carriers was 1,135 miles.

The forecasts of enplaned tonnage were obtained by dividing the domestic air cargo revenue ton-mile forecasts by the projected average haul distances. It was assumed that domestic air cargo average length of haul distances for passenger/cargo and all cargo carriers respectively remain constant at their 1978 levels throughout the forecast period.

Passenger/cargo and all cargo tons enplaned forecasts for 38 individual airports were developed based on the assumption that the 1978 geographic distribution of air cargo shipments and each airport's 1978 passenger/cargo and all cargo tons enplaned market shares remained unchanged throughout the forecast period.

A top-down approach is adopted to disaggregate total domestic enplaned tons into forecasts of enplaned tons at selected airports. The procedure involves the following steps. Forecasts of total domestic cargo enplaned tonnage are the sum of the forecasts of passenger/ cargo carrier tonnage and the forecasts of all cargo carrier tonnage. The forecasts of enplaned tonnage by passenger/ cargo carriers and all cargo carriers were obtained by dividing the forecasts of revenue ton-miles by their corresponding forecasted average line hauls. Finally, tons enplaned at selected airports are obtained by disaggregating total domestic tonnage forecasts based on the market share of the selected airports with respect to total domestic enplaned tons.

International Air Cargo Model

In this section, the model structures for both inbound and outbound international air cargo traffic activity from U.S. airports are discussed. The empirical results of the selected models and the forecasting assumptions used to produce annual forecasts of international air cargo activity are also presented.

The Model. It is well known that the demand for transportation services is a derived demand. Transportation services have no intrinsic value in commodity shipment. These services are only important because they move goods from point of production to point of final use. Therefore, U.S. international air cargo activity is expected to depend on the state of the U.S. and world economic conditions. More specifically, the general demand for air freight services (outbound) depends on the following factors: air freight rates, quality of air freight services, quality of surface freight, other freight rates, and the economic situation of the specified world region. Similarly, the general demand for air cargo activity (inbound) is influenced by the same factors that influence the demand for air cargo activity (outbound) except that the economic conditions of the specific world regions are now replaced by the conditions prevailing in the U.S. These considerations are the bases on which the empirical models are constructed. However, there are no reliable quantitative measures for air cargo and surface freight services, or any published composite index of surface freight rates comparable to the rates for the world regions defined in this study. For these reasons, the empirical models of the demand for air cargo services (outbound) and air cargo services (inbound) are specified as follows:

$$E_{it}^{(\lambda)} = \alpha_0 + \alpha_1 Y_{it}^{(\lambda)} + \alpha_2 P_{it}^{(\lambda)} + e_{it} \qquad (11)$$

$$I_{it}^{(\lambda)} = \beta_0 + \beta_1 Y_{US,t}^{(\lambda)} + \beta_2 P_{it}^{(\lambda)} + U_{it} \qquad (12)$$

where

E_{it} = tons of air cargo outbound to the i^{th} world region

Y_{it} = regional gross domestic product converted with the appropriate national exchange rates and deflated using the implicit U.S. GNP deflator

P_{it} = regional air cargo price proxy based on average revenue yield per ton-mile for representative U.S. air carriers deflated by the implicit U.S. GNP deflator

I_{it} = tons of air cargo imports to the U.S. from region i

$Y_{US,t}$ = U.S. GNP in 1972 dollars

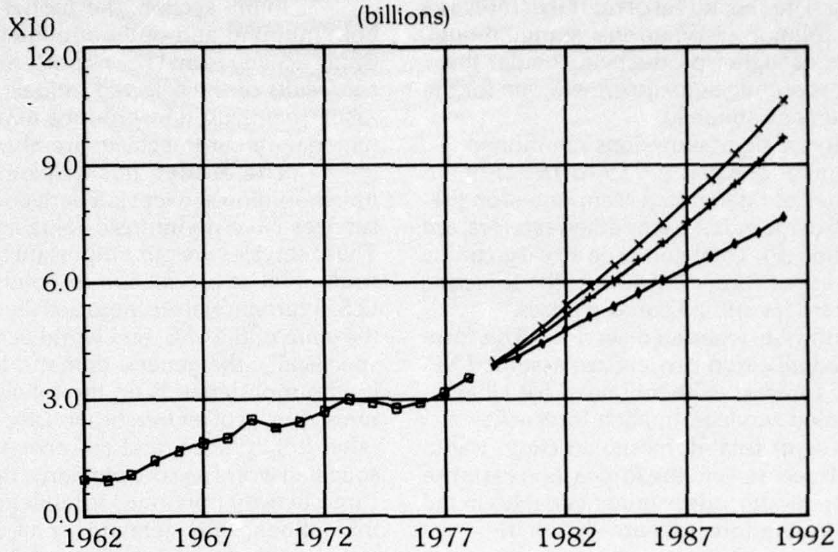
e_{it} and U_{it} denotes the error terms of the equations.

The historical data for international air cargo traffic activity from and to U.S. airports are available from *Freight Trade Statistics* published by the Department of Commerce and disaggregated into the six world regions for U.S. flag carriers and all air carriers.

The Empirical Results. Time series data from 1964 to 1977 are used to estimate the parameters of the models specified in equations (11) and (12). For U.S. flag carriers, there are six estimated outbound equations from

Figure C-1
U.S. Domestic Revenue Ton-Miles

(billions)



Forecast utilizes 1972 dollar GNP values from Wharton's annual model, December 6, 1978, Post-Meeting Higher Productivity (average annual growth rate 3.2%)

Upper Line — Domestic 1972 dollar average revenue per ton-mile yield decline 1.1% annually for passenger/cargo carriers and .4% annually for all-cargo carriers

Middle Line — Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level

Lower Line — Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yield increase 2% annually

Table C-3
Total Domestic Air Cargo Revenue Ton-Mile Forecast

(millions)

Year	Increasing[1] Air Cargo Prices	Constant[2] Air Cargo Prices	Declining[3] Air Cargo Prices
1979	3858.61	3941.65	3985.25
1980	4089.50	4265.89	4356.96
1981	4436.20	4721.35	4866.76
1982	4797.00	5204.76	5410.51
1983	5112.27	5652.55	5922.74
1984	5378.48	6059.03	6396.91
1985	5731.28	6571.36	6985.51
1986	6033.76	7040.52	7533.55
1987	6328.65	7512.96	8089.43
1988	6612.68	7984.77	8648.91
1989	6947.57	8527.08	9287.11
1990	7261.07	9057.52	9916.90
1991	7650.61	9691.16	10660.90

Forecast utilizes 1972 dollar GNP values from Wharton's annual model.

[1]Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yield increase 2% annually.

[2]Domestic passenger/cargo and all cargo 1972 dollar average revenue per ton-mile yield held constant at 1978 level.

[3]Domestic passenger/cargo 1972 dollar average revenue per ton-mile yield declines 1.1% annually. Domestic all cargo 1972 dollar average revenue per ton-mile yield declines .4% annually.

U.S. airports, one for each of the six world regions, and six estimated inbound equations, one for each of the six world regions to U.S. airports. There are six estimated (outbound) equations and six estimated (inbound) equations for all air carriers. In total, there are 24 estimated regression equations. Following the procedures used above, the choice of the functional form is based on the results obtained from the Box-Cox techniques and prior knowledge about future possible behavior of air cargo traffic.

The estimated (outbound) equations of all air carriers for the six world regions are reported in Table C-4. Because of space limitations, the set of the estimated equations are not reported here.

Based on the empirical results, the coefficients of GNP in 1972 dollars in the inbound equations and the coefficients of gross domestic product (GDP) for world regions in the outbound equations possess positive signs and are statistically significant at least at the 5 percent level. This result supports the general belief that U.S. international air cargo traffic depends on domestic and world regional economic conditions. Almost all of the air cargo price variable coefficients have negative signs but one fourth of the estimated coefficients are not statistically significant at the 10 percent level.

Forecasting. The long-term annual forecasts of air cargo were generated using a two-step forecasting procedure. First, the values of the independent variables beyond the sample period were extrapolated into the future under varying assumptions. Secondly, these extrapolated values for the exogenous variables were substituted into the estimated equations to obtain the forecasts for the dependent variable.

Specifically, the forecasting results for the six international trade areas were obtained under the following assumptions:

1) Three alternative price scenarios were used. In particular revenue yield per ton-mile was assumed to:
   a) increase 2% annually
   b) remain constant at the 1977 level
   c) decline at an annual rate equal to the average rate from 1964 to 1977. A minimum price of \$.20 (1977=100) was established. This was adopted to avoid the problem of obtaining negative prices when extrapolating a price decline into the future.
2) The forecasts of GNP were obtained from the Wharton Annual and Industry Forecasting Model
3) Future values for GDP for all world regions are based on their corresponding average annual rate of growth from 1964 to 1977.

Table C-4
Estimated Outbound Equations of All Air Carriers for the Six World Regions

(a) North America

$$E_{it}^{(.6)} = \underset{(2.49)}{1401.07} + \underset{(12.83)}{95.1754^*} Y_{lt}^{(.6)} \underset{(-3.46)}{-247.676^*} P_{lt}^{(.6)}$$

$$\bar{R}^2 = .9518 \quad F(2/11) = 129.347 \quad DW = 1.41$$

(b) South America

$$E_{2t}^{(.4)} = \underset{(0.14)}{11.8926} + \underset{(6.08)}{18.2908^*} Y_{2t}^{(.4)} - \underset{(-0.46)}{8.94307^*} P_{2t}^{(.4)}$$

$$\bar{R}^2 = .8717 \quad F(2/11) = 45.147 \quad DW = 1.34$$

(c) Europe

$$E_{3t}^{(.4)} = \underset{(4.80)}{228.482} + \underset{(11.09)}{13.6275^*} Y_{3t}^{(.4)} - \underset{(-7.74)}{79.1895^*} P_{3t}^{(.4)}$$

$$\bar{R}^2 = .968 \quad F(2/11) = 197.470 \quad DW = 1.99$$

(d) Asia

$$E_{4t}^{(.5)} = \underset{(1.67)}{155.607} + \underset{(14.35)}{24.7132^*} Y_{4t}^{(.5)} \underset{(-5.58)}{-66.0325} {}^*P_{5t}^{(.5)}$$

$$\bar{R}^2 = .9924 \quad F(2/11) = 848.688 \quad DW = 1.25$$

(e) Australia & Oceania

$$E_{5t}^{(.4)} = \underset{(-0.23)}{-8.48392} + \underset{(5.24)}{19.1535^*} Y_{5t}^{(.4)} \underset{(-1.53)}{-9.94549^*} P_{4t}^{(.4)}$$

(corrected for first order autocorrelation, rho = .7459)

$$\bar{R}^2 = .801 \quad F(2/11) = 27.103 \quad DW = 1.32$$

(f) Africa

$$E_{6t}^{(.6)} = \underset{(-1.21)}{-132.448} + \underset{(18.46)}{60.0492^*} Y_{6t}^{(.6)} - \underset{(-3.03)}{36.4214^*} P_{4t}^{(.6)}$$

(corrected for first order autocorrelation, rho = .1575)

$$\bar{R}^2 = .987 \quad F(2/11) = 289.055 \quad DW = 2.05$$

*The numbers in parentheses under the equations are the associated t-statistics of the coefficients

4) The estimated relationships are likely to continue throughout the forecast period.

Following these forecasting assumptions and procedures, long run alternative forecasts for tons were obtained using a two-stage procedure. The lack of ton-mile data comparable to the rates for the world regions defined in this report necessitated forecasting ton-miles for international cargo in two stages. The procedure used to derive forecasts for ton-miles consisted of: forecasting tonnage for international cargo (tonnage data was used because of its timeliness and availability), and applying a conversion factor, based on distance estimates to obtain forecasts for international cargo. More specifically, these mileage estimates or average length of haul for each of the six world regions were calculated. This method relied upon a determination of the number of statute miles between the major U.S. hubs of international cargo activity serving a region and the capital cities for each country within the particular regions. These estimates provided the average length of haul (to and from the region) which, when multiplied by the tonnage forecasts, yielded the desired ton-mile estimates.

Table C-5 presents the summary, baseline forecasts of cargo enplaned tons and cargo ton-miles for total U.S. international air cargo traffic (freight plus express), all services from all U.S. airports. Total international air cargo traffic, all services, is the sum of inbound and outbound cargo traffic. The top-down approach discussed earlier is also used to disaggregate international air cargo traffic at the 28 selected U.S. air hubs.

Table C-5
U.S. International Air Cargo Traffic*
All Services From All U.S. Airports

	Revenue-Cargo Enplaned Tons (thousands)			Revenue-Cargo Ton Miles (millions)		
Calendar	U.S. Flag Carriers	Foreign Flag Carriers	Total	U.S. Flag Carriers	Foreign Flag Carriers	Total
1979	685	1112	1797	2986.78	4687.46	7674.26
1980	736	1205	1941	3226.27	5106.72	8333.00
1981	916	1349	2165	3607.59	5758.65	9367.24
1982	902	1507	2409	4022.97	6479.98	10102.95
1983	985	1650	2635	4421.79	7183.24	11605.03
1984	1064	1790	2875	4806.44	7870.23	12676.67
1985	1164	1999	3163	5292.50	8739.84	14032.33
1986	1259	2176	3435	5749.62	9567.39	15317.02
1987	1357	2363	3720	6227.87	10438.73	16666.62
1988	1457	2519	4016	6724.00	11347.68	18071.68
1989	1574	2782	4356	7293.84	12396.58	19690.44
1990	1689	3007	4696	7865.07	13453.31	21318.34
1991	1825	3270	5095	8536.59	14703.20	23239.70

*Includes (freight plus express)

*Forecasts were generated using forecasting assumptions 1B, 2, and 3 of the Forecasting Methodology Section

Glossary of Terms

Aerial Application
Aerial application in agriculture consists of those activities that involve the discharge of materials from aircraft in flight and miscellaneous collection of minor related activities that do not require the distribution of any materials.

Aircraft Contacted
Aircraft with which the Flight Service Stations have established radio communications contact. One count is made for each enroute, landing or departing aircraft contacted by Flight Service Station regardless of the number of contacts made with an individual aircraft during the same flight.

Aircraft Operation
An aircraft arrival or departure from an airport with FAA airport traffic control service. There are two types of operations—local and itinerant.

1. Local operations are performed by aircraft which:
   (a) Operate in the local traffic pattern or within sight of the tower.
   (b) Are known to be departing for, or arriving from, flight in local practice areas located within a 20-mile radius of the control tower.
   (c) Execute simulated instrument approaches or low passes at the airport.
2. Itinerant Operations:
   All aircraft arrivals and departures other than local operations.

Airport Traffic Control Tower
A central operations facility in the terminal air traffic control system, consisting of a tower cab structure, including an associated IFR room if radar equipped, using air/ground communications and/or radar, visual signaling and other devices, to provide safe and expeditious movement of terminal air traffic.

Air Route Traffic Control Center
A central operations facility in the air route traffic control system using air/ground communications and radar, primarily providing enroute separation and safe, expeditious movement of aircraft operating under instrument flight rules within the controlled airspace of that center.

Air Taxi Operations
Air taxi operations and commuter air carrier operations (takeoffs and landings) carrying passengers, mail or cargo for revenue in accordance with FAR Part 135 or Part 121.

Air Taxi Operators
Operators of small aircraft "for hire" for specific trips. They operate under CAB Part 298 and FAR 135 which apply to aircraft of 12,500 pounds or less except under special exemption.

Air Traffic Hub
Air traffic hubs are not airports; they are the cities and Standard Metropolitan Statistical Areas requiring aviation services and may include more than one airport. Communities fall into four classes as determined by each community's percentage of the total enplaned passengers.

Large 1.00% (2,071,729 passengers and over in FY 1976)

Medium: 0.25% to 0.99% (between 517,932 and 2,071,728 passengers in FY 1976)

Small: 0.05% to 0.24% (between 103,586 and 517,931 passengers in FY 1976)

Nonhub: Less than 0.05% (under 103,585 passengers in FY 1976)

All Cargo Carrier
One of a class of air carriers holding certificates of public convenience and necessity issued by the CAB, authorizing the performance of scheduled air freight, express, and mail transportation over specified routes, as well as the conduct of nonscheduled operations, which may include passengers.

Approach Control Facility
A terminal air traffic control facility providing approach control service.

Available Seat-Miles
The aircraft miles flown in each flight stage multiplied by the number of seats available on that stage length for revenue passenger use.

Business Transportation
Any use of an aircraft not for compensation or hire by an individual for the purposes of transportation required by a business in which he is engaged.

Certificated Route Air Carrier
An air carrier holding a certificate of public convenience and necessity issued by the Civil Aeronautics Board to conduct scheduled services over specified routes. Certain nonscheduled or charter operations may also be conducted by these carriers.

Common IFR Room
A highly automated terminal radar control facility. It provides terminal radar service in an area encompassing more than one major airport which accommodates instrument flight operations.

Commuter Operator
Operators of small aircraft of a maximum size of 30 seats and a 7,500 pound payload who perform at least five scheduled round trips per week between two or more points or carry mail. They operate under CAB Part 298, FAR 135, and at times FAR 121.

Contract Operator
An air carrier operating on a private for-hire basis, as distinguished from a public or common air carrier, holding a commercial operator certificate (issued by the FAA under FAR 121) authorizing the carrier to operate aircraft over 12,500 pounds for the transportation of goods or passengers for compensation or hire.

Domestic Trunk Carriers
One of a group of certificated route air carriers which operates primarily within and between the 50 States of the United States and the District of Columbia over routes serving primarily the larger communities.

Executive Transportation
Any use of an aircraft by a corporation, company or other organization for the purposes of transporting its employees and/or property not for compensation or hire and employing professional pilots for the operation of the aircraft.

FAA Flight Plan
Specified information relating to the intended flight of an aircraft that is filed orally or in writing with a flight service station or an air traffic control facility.

Flight Service Station (FSS)
Air Traffic Service facilities within the National Airspace System which provide preflight pilot briefing and enroute communications with VFR flights, assist lost IFR/VFR aircraft, assist aircraft having emergencies, relay ATC clearances, originate, classify, and disseminate Notices to Airmen, broadcast aviation weather and NAS information, receive and close flight plans, monitor radio NAVAIDS, notify search and rescue units of missing VFR aircraft, and operate the National weather teletypewriter systems. In addition, at selected locations, FSSs take weather observations, issue airport advisories, administer airman written examinations, and advise Customs and Immigration of transborder flight.

Foreign-Flag Air Carrier
An air carrier other than a U.S. flag air carrier in international air transportation. "Foreign air carrier" is a more inclusive term than "foreign-flag air carrier," presumably including those non-U.S. air carriers operating solely within their own domestic boundaries; but in practice the two terms are used interchangeably.

General Aviation
All civil aviation activity except that of certificated route air carriers and air commuter operations. The types of aircraft used in general aviation (GA) activities cover a wide spectrum from corporate multiengine jet aircraft piloted by professional crews to amateur-built single-engine piston acrobatic planes, balloons and dirigibles.

IFR Aircraft Handled
The number of IFR departures multiplied by two plus the number of IFR overs. This definition assumes that the number of departures (acceptances, extensions, and originations of IFR flight plan) is equal to the number of landings (IFR flight plans closed).

Industrial/Special Flying
Any use of an aircraft for specialized work allied with industrial activity; excluding transportation and aerial application. (Examples: pipeline patrol, survey, advertising, photography, helicopter hoist, etc.)

International and Territorial Operations
Operators of aircraft flying between the 50 States of the United States and foreign points, between the 50 States and U.S. possessions or territories, and between foreign points. Includes both the combination passenger/cargo carriers and the all cargo carriers engaged in international and territorial operations.

Intrastate Air Carrier
A carrier licensed by a state to operate wholly within its borders but not permitted to carry interline passengers from out of state. They are not regulated by the CAB.

Instructional Flying
Any use of an aircraft for the purpose of formal instruction with the flight instructor aboard or with the maneuvers on the particular flight(s) specified by the flight instructor.

Instrument Operation
An aircraft operation in accordance with an IFR flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility or air route traffic control center.

Local Service Carriers
Certificated domestic route air carriers operating routes of lesser density between the smaller traffic centers and between those centers and principal centers.

Other Use Flying
Use of general aviation aircraft for purposes other than those in specific categories, such as business, personal, air taxi.

Personal and Pleasure Flying
Any use of an aircraft for personal purposes not associated with a business or profession, and not for hire. This includes maintenance of pilot proficiency.

Pilot Briefing
A service provided by the Flight Service Station to assist pilots in flight planning. Briefing items may include weather information, NOTAMS, military activities, flow control information and other items as requested.

RAPCON
Radar Approach Control Facility (Air Force).

RATCF
Radar Approach Control Facility (Navy).

Registered Active General Aviation Aircraft
A civil aircraft registered with the FAA that has been flown one or more hours during the previous calendar year. Excluded are aircraft owned and operated in regularly scheduled, nonscheduled, or charter service by an air carrier certificated by the Civil Aeronautics Board or aircraft in excess of 12,500 pounds maximum gross takeoff weight owned and operated by a commercial operator certificated by the FAA to engage in intrastate common carriage.

Revenue Passenger Enplanements
The count of the total number of passengers boarding aircraft. This includes both originating and connecting passengers.

Revenue Passenger Load Factor
Revenue passenger miles as a percent of available seat miles in revenue passenger services, representing the proportion of aircraft seating capacity that is actually sold and utilized.

Revenue Passenger Mile
One revenue passenger transported one mile in revenue service.

Revenue Ton Mile
One ton of revenue traffic transported one mile.

Secondary Airport
An airport receiving approach control service as a satellite to a primary approach control facility, or one at which control is exercised by the approach control facility under tower enroute control procedures.

Supplemental Air Carrier
One of a class of air carriers holding certificates, issued by the CAB, authorizing them to perform passenger and cargo charter services supplementing the scheduled service of the certificated route air carriers. They are sometimes referred to as nonscheduled carriers.

Total Flight Services
The sum of flight plans originated and pilot briefs, multiplied by two, plus the number of aircraft contacted.

U.S. Flag Carrier or American Flag Carrier
One of a class of air carriers holding a certificate of public convenience and necessity issued by the CAB, approved by the President, authorizing scheduled operations over specified routes between the United States (and/or its territories) and one or more foreign countries.